THE UNIVERSITY OF ALBERTA

THE INFLUENCE OF FACULTY, HIGH SCHOOL SIZE, AND SEX IN THE PREDICTION OF FRESHMAN SUCCESS USING DEPARTMENTAL AND PRINCIPALS' RATING GRADE XII SCORES

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The undersigned hereby certify that they have read and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled "The Influence of Faculty, High School Size, and Sex in the Prediction of Freshman Success Using Departmental and Principals' Rating Grade XII Scores", submitted by Donald Knowles, in partial fulfillment of the requirements for the degree of Master of Education.

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ABSTRACT

This thesis was based on the problem of improving the prediction of freshman success at the University of Alberta, Edmonton with high school marks. The improvement in predictive efficiency by categorizing the data by size of graduating high school, sex of student, and faculty entered at university was studied. On the basis of the categorization found to be justified, the relative predictive values of two sets of high school marks--the Grade XII Departmental Examination and the Principals' Rating scores--were compared.

The sample of students considered in the study was 1017 freshman students who had entered the Faculties of Arts, Education, Engineering, and Science in 1962 and for whom complete Departmental and Principals' Rating data was available. The analyses of this data led to the findings that:

1. consideration of the size of graduating high school, as determined by the number of teachers on staff, as small and large schools was justified. Marks of students from large schools were superior to marks of students from small schools in their correlation with university average.

2. marks of female students generally were better predictors of freshman success than were marks of male students. Categorization of data by sex was justified.

3. differentiation of the criterion scores on the basis of faculty led to the finding that high school marks correlated more highly

with university average in Engineering and Science than with the average in Arts and Education.

4. the Principals' Rating scores were generally as effective as the Departmental scores in their ability to predict the freshman average. For only one of the fourteen subgroups evolved was the Departmental battery a significantly better predictor.

It was concluded that, for the purposes of educational counselling and provisional university admission before the end of the Grade XII program, the Principals' Ratings could be used effectively to predict freshman success at the University of Alberta. Further, this prediction would be enhanced by the consideration of the sex, size of the graduating high school, and the faculty the student intended to enter.

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INTRODUCTION

In a modern technological age, the efficient use of human resources has become a challenge to the institutions of society. It has become axiomatic that our talent must be identified and our manpower developed if maximal productivity is to be reached and sustained. From the individual's point of view, reaching a level of self-fulfillment and achievement enhances his well-being.

Because today's educational systems play such an important role in the identification and development of each child's talents, the fabric of educational objectives has the thread of the self-actualization goal running throughout. As the educational programs have become increasingly diversified, there has been a substantial and continuous increase in the variety and number of decisions that must be made which concern each student. The curriculum route chosen, for example, has direct implications on each student's subsequent choice of vocational area.

Coupled with this increase in the number of educational routes is the growing pressure for advanced education in virtually every field. Wrenn (1962) has pointed out that no other factor is as important to the labor force entrants of the 1960's as the level of education they have attained. Not only must the student reach a decision regarding his general field of endeavor, he must spend an increasing length of time in his educational preparation.

It is no accident that major efforts have been devoted to the

efficient prediction of a person's success in a position or program. Fishman and Pasanella (1960), for example, have reviewed over six hundred college admission studies published since Garrett's (1949) and Travers' (1949) well known papers in the same area. It is not the purpose of this study to review predictive studies in areas other than those relating to the articulation between the high school and college but the increased emphasis on selection and placement in business and industry since World War II is well known. It would seem that any variable that has shown signs of being measurable and valuable as a predictor has been seized upon in the hope that something better than a guess can be made regarding a person's possible success in a specified task.

Such a specified task is the university program. Woodside (1958), in reviewing what he calls the "Canadian crisis in higher education," says that the growing problem to be faced regarding university education can be expressed in two ways. First, there is a mounting "tidal wave" of students who will want to go to university. The tidal wave is well illustrated by the published data of the Dominion Bureau of Statistics. In 1890, only three per cent of students went to university as compared to 8.8 per cent in 1957. The Bureau has predicted that percentages will increase to 10 per cent by 1965 and to 12.7 per cent by 1973. (Woodside, 1958; p. 23.) The percentage increase in students desiring to attend university will be compounded both by a generally increasing population and by general prosperity which will allow young adults to study for longer periods. Sheffield has estimated that there will be a four-fold increase of university students within twenty years of 1955

(Woodside, 1958: pp. 18-20). Early in the predicted period, these figures have already been found to be very conservative. Secondly, the needs of the country for men and women in education, business, science, medicine, and other fields has not been met. A universal shortage of the well-educated already exists in many fields and this will accelerate as our industrial complex automates.

In this situation in which more students are enrolling in university programs and more university graduates are needed, Canadian universities are far from satisfied with the utilization of talented youth. In 1956, Dr. Andrew Stewart, then president of the University of Alberta, said:

> Too many students who are admitted find it impossible, under conscientious direction of their instructors, to meet reasonable requirements for promotion.... We do not know how many competent students fail to reach University, but the number is probably large (Jackson and Fleming, 1957: p. 80).

T. H. Matthews, another Canadian educator, likens the attrition in the universities to a disease that affects thousands of young Canadians. He has observed that about one-third of the high school students who come to the universities fail to graduate primarily for academic reasons (Matthews, 1957).

Further to the serious problem of many failures at university is the tremendous wastage of talent resulting from drop-outs during or immediately after high school. Hollinshead has estimated that of the one-quarter of the total U. S. population with I Q ratings of more than 110, only four-fifths finish high school and only two-fifths enrol in university (Woodside, 1958). Canadian studies have found similar

attrition rates. Jackson's study of Province A, thought to be Ontario, found that up to 90 per cent of the most intelligent of Canadian young people, I Q over 140, fail to finish high school (Woodside, 1958; p. 54). A longitudinal study in Alberta was concerned with the academic progress of 100 students enrolled in grade nine in 1949 (Jackson and Fleming, 1957; p. 87). Only nine of these 100 students secured their university entrance; only four had received or were still working for their university degrees in 1955. Black (1961) in his Alberta survey of the academically gifted does not agree with the dramatic figures cited above by Woodside, but although the percentage is lower, the wastage is too high to ignore.

The seriousness of this wastage has led educators to ask many piercing questions, foremost of which has been, "Who should go to college?" From the individual's point of view, the answer could be to accept all those who have both the desire to attend university and the capabilities which could be further developed in the university program. From the point of view of society, the ablest of youth should attend to maximize contributions to society. The current high failure rate at universities, as well as the observations that many able students are not enrolling in university, would seem to indicate that the problem of "who should go to college" has not been solved satisfactorily.

Solutions to the problem which have been attempted assume that there is some method of predicting an individual's need for and chances of success in university study. Angell (1959) asked if the problem was one of students failing in one program when they might have succeeded

in another, or one of completely failing to identify those who will benefit most from a university education. Both problems could very well exist. There is an immediate need for gathering the prognostic data together, testing its value, and then making worthwhile data available to senior students, high school counsellors and university admission officers.

The Problem

The present study was concerned with the general problem of predicting academic success at the University of Alberta, Edmonton. More particularly, it was concerned with the comparative predictive abilities of high school achievement marks--Departmental Examinations and Principals' Ratings. Multiple differential correlation techniques were used to determine the comparative value of the two batteries of predictors and the necessary differentiations to make among the data to maximize predictive accuracy.

Discussion of the Problem

Predictive problems, such as indicating chances of success at the University of Alberta, appear to consist of three parts. The first is the task of selecting individuals according to predicted fulfillment of some specified criteria. The second part of the problem is one of classifying or assigning an individual to one of several categories, for instance, courses of study. Thirdly, there is the educational and vocational guidance problem of supplying information and assistance so that:

> ... the counselee can judge the relative desirability of certain courses of action by considering these facts along with training time involved, monetary considerations, social prestige, or the like (Gleser, 1960; p. 1039).

Essentially, prediction problems may be problems of selection, classification, and guidance. Each of these three areas is of concern in Alberta regarding plans for and entrance to the University of Alberta.

Results of the Grade XII Departmental Examinations are presently used as the selection criteria to the University of Alberta. These examinations are administered for the Grade XII subjects--English 30 (Literature 30 and Language 30), Social Studies 30, Mathematics 30, Sciences (Chemistry 30, Physics 30, and Biology 32), and a foreign language. The tests are prepared for the Department of Education by appointed school officials and are subject to review and approval by an examination committee in each subject. The battery of tests is administered at the end of June to all qualified Grade XII students in the province. The tests are composed of multiple-choice items, written short answer items, and full essay-type items in varying proportions. The examinations are marked by officials employed by the Department and the marks are standardized.

The general view, expressed by Stewart above, that present selection procedures are not entirely satisfactory has resulted in a plea by university authorities that they be given more information about prospective students. Many admission officers, particularly in the United States, have asked for the high school record of the student and a confidential record from his principal as supporting evidence of a

student's chances of success in the university program.

In Alberta, there exists such a report for the Department of Education. The Principals' Confidential Report is required for each student enrolled in one or more Grade XII Departmental subjects. This report is in the form of a percentage mark for each Grade XII subject. Although it is called the Principals' Rating, it is usually a prediction by each subject teacher of the student's probable mark in the Departmental examination. By custom, the Grade XII Principals' Rating is based to a large extent on the results of Easter examinations and on the year's course work. Its main function, to date, has been to serve as a basis for assigning a mark to those few students who, for compassionate reasons, are unable to write the Departmental Examinations. A problem undertaken in the present study was to determine if these Principals' Ratings were, in fact, a valid indication of the student's academic achievement and, as such, a useful predictor of future academic success.

An additional problem of selection of university candidates was discussed by Dr. Walter Johns, president of the University of Alberta, at a recent conference of Canadian university presidents (Johns, 1961). The differing standards of entrance for each Canadian university has created many problems due, in part, to the mobility of Canadian families. The possibility of instituting a national college entrance examination has been suggested as a means of selecting students (Johns, 1961; Black, 1963; Graham, 1964). The evaluation of such an examination would be facilitated by local research to establish the

effectiveness of present predictors. Since the Principals' Ratings are available in Alberta without an additional testing program, their validity in selecting university candidates could serve as a useful guideline.

The predictive problem of classification exists in many forms at the University of Alberta. Not only must a decision be made regarding the admission of a student to university, but his placement in one of several faculties and schools must be made. As Angell (1959) emphasized, it is very possible that a student's chances of success in one program are quite different than his chances in another program.

The problem of supplying information to the student about his probable success at university was also considered in the present study. The dichotomy of clinical versus statistical prediction is basic to education guidance. Meehl (1954) has perhaps led the inquiry into the comparative effectiveness and has emphasized the possible economy in the use of clinicians' time if statistical predictions are found to be as valid as clinical. Meehl has said:

> It is my personal hunch...that a very considerable fraction of clinical time is being irrationally expended in the attempt to do, by dynamic formulations and staff conferences, selective and prognostic jobs that could be done more efficiently... through systematic and persistent cultivation of complex (but still clerical) statistical methods. (Rosen and Van Horn, 1961; p. 150)

Several studies (Black, 1960; Evenson and Smith, 1958; Mack, 1963; Zurowsky, 1959) have been conducted in Alberta to determine the statistical data needed to predict success at the University of Alberta from the Grade XII Departmental results. A problem undertaken in the

present study was to supply information to the high school student on the basis of the Principals' Ratings which, in contrast to the Departmental results, are available well before the end of the school year.

It has been suggested by Henry (1950) that those concerned with the prediction of university success have a duty to continue research aimed at the improvement of predictive efficiency of already-identified predictors, the search for new predictor variables, and the decreasing of time and cost of the predictive program. The present study attempted to contribute to the improvement of predictive efficiency and to the search for new predictors of academic success at the University of Alberta by considering the relationship of the sex of the freshman, the size of high school he attended, and the faculty he entered to his academic success in that faculty.

CHAPTER II

REVIEW OF RESEARCH

The desire to make accurate predictions of success in university has brought about a multitude of research studies which have examined many variables. Recently, new statistical techniques and modern computers have enabled investigators to examine readily more variables, to conduct cross-validation studies, and to combine the predictor variables in various combinations.

The number and type of predictor variables that have been studied is a tribute to intellectual curiosity. One reviewer, Zurowsky, (1959) found that the following factors were being considered in predictive studies:

> ...intelligence, aptitude, achievement, motivation, persistence, attitude, personality, interest, age, sex, time spent in study, reading ability, athletic ability, personal history, rank in high school class, determination to go to college, English expression, study habits and empathy. Then also there has been recognition of spontaneous and uncontrollable factors which cannot be forseen...health conditions, social circumstances, sexual distractions, home problems, temporary moods, sets and fatigue. (p. 12).

Such factors have varied in both measurability and effectiveness as predictors.

Previous Reviews

Reviews by Travers (1949), Garrett (1949), and Henry (1950) are the major surveys of predictive studies.

Travers (1949) recounted that early studies were concerned with the prediction of over-all success at the university level. Such studies

found that the high school average was consistently the best single predictor. Following in order of validity as predictors were subject matter tests and tests of scholastic aptitude. He also found that consistently low correlations were derived in studies of non-intellectual factors, such as level of adjustment and interests. He added that motivational factors played a major role in determining academic success but that such factors could not be adequately measured with existing instruments. He observed that more recent studies (1949) had been concerned with differential predictions of academic success in specific areas and such studies had shown it to be a promising approach.

Garrett's review (1949) was very extensive, covering hundreds of studies. He, too, found that the high school average continued to show the highest correlation with college scholastic average. In thirty-two studies, the correlation of high school average to university average ranged from .29 to .82, with a median of .56. He found that the high school average predicted the first year college average better than it predicted any lesser or greater part of the college course. Garrett found that of the many forms of presenting a student's high school achievement, the high school average and percentile rank-in-class were most commonly used. By combining the variables of high school average and high school percentile rank, investigators arrived at a multiple correlation with university success of between .60 and .65. Garrett concluded that research showed the three best predictors of university success to be high school scholarship, general achievement tests, and intelligence test scores.

Henry (1950) also concluded that high school achievement had been shown to be the best single predictor. College aptitude tests were found to correlate from .25 to .75 with college success, being fairly valid if devised for and used by a specific college. Personality measures failed to demonstrate any appreciable relationship with university success in most studies. There was a negative correlation ($r = -.25$) between age and college success apparently due to the fact that those students who finish high school at a comparatively early age have had greater academic success in high school. Other factors, such as size of family, nature of part-time employment, and parental occupation, showed either no relationship or inconsistent correlations.

Alberta Studies

The research findings that high school achievement, standardized general achievement tests, and intelligence test scores are the best predictors of university success have been tested in Alberta.

Comprehensive studies in this field in Alberta began in late 1954 with the establishment by the Department of Education of a Matriculation Study Subcommittee whose purpose it was to examine the "validity of the present predictive system of selecting students for university education" (Evenson and Smith, 1957, p. 68). The first project of the subcommittee was to examine the most recent, complete academic record of a university graduating class. The freshman class of 1951 was selected for study. The study was concerned with the predictive validity of such factors as Grade XII Departmental results and

the American Council on Education's (ACE) Psychological Examination (Evenson and Smith, 1958).

The results, reported in Table I, supported the finding of other studies that Grade XII achievement record is a better single predictor of university freshman success than an intelligence test (ACE). Further, the ACE consistently showed a smaller correlation with university average of each subsequent year of university program compared to the correlation derived by using Grade XII results. The 1951 Freshman Study also found that the best predictor of senior years' success in university was the freshman average (Table I). A major weakness of this study was that the group of subjects for one predictor variable was not the same as the group of subjects for any other variable. The number of subjects in the comparison groups ranged from 116 to 881, with a median size of 181 subjects. It would appear impossible to make precise comparisons between the correlation coefficient as, apparently, the size and nature of the comparison groups was not controlled.

A second project of Matriculation Study Subcommittee was a study of the 1956 Grade XII graduating class in Alberta. Having found in the 1951 Freshman Study that the Grade XII Departmental mark was the best single predictor of first year university success, the subcommittee investigated the relationship between Grade XII marks and other predictors. Specifically, the College Entrance Examination Board's (CEEB) achievement battery and Scholastic Aptitude Test (SAT) as well as the School and College Ability Test (SCAT) were studied (Evenson and Smith,

TABLE I

CORRELATIONS BETWEEN UNIVERSITY AVERAGE AND GRADE XII DEPARTMENTAL AVERAGE AND ACE TOTAL SCORE FROM 1951 FRESHMAN STUDY

(After Evenson and Smith, 1958)

CRITERION	PREDICTOR*			Type of Student
	Grade XII Av.	ACE	1st Year Univ. Av.	
First Year University Average	.48	.36	-	All Faculties
	.58	.34	-	Arts and Science
	.59	.26	-	Engineering
	.54	-	-	Educ. (B. Ed.)
Second Year University Average	.54	.16	.63	All Faculties
Third Year (Grad.) University Average	.36	.15	.45	All Faculties
Fourth Year (Grad.) University Average	.50	.18	.47	All Faculties

*Comparison Groups Differ (N 116 ⟷ 881 Median = 181)

1957).

The CEEB examinations have been used for many years by many universities in the U.S.A. as one basis for the selection of university students. The College Entrance Examination Board actually serves in an advisory and supervisory capacity to the Educational Testing Service which prepares the tests and conducts the examination program. In a study termed "The 1956 Grade XII Survey," the Alberta subcommittee chose seven of the CEEB achievement tests and SAT to administer to all Alberta Grade XII students. A province-wide sample of 1435 students was drawn. The students were assigned to 21 groups representing all possible combinations of two CEEB achievement tests from the battery of seven possible. Each student, then, wrote two of the CEEB tests corresponding to his Grade XII program. Correlations between the CEEB test results and the corresponding Departmental results were computed. The correlation coefficients ranged from 0.58 to 0.77, with a median correlation of 0.71 (Evenson and Smith, 1958). Despite the fact that the CEEB examinations were written for and normed on a U.S. population, they apparently correlate well with Alberta Grade XII Departmentals considering the differing types of instruments.

The next step of the 1956 Grade XII Survey was to test the validity of the data gathered in the special testing program to predict university success. Correlations between CEEB test scores and university first year average were compared with correlations between Departmental marks and university average for the 1956 freshman class (Table II). Although the significance of differences was not computed, due perhaps

TABLE II

CORRELATIONS BETWEEN DEPARTMENTAL GRADE XII SUBJECT AND CEEB ACHIEVEMENT TEST SCORES AND FRESHMAN UNIVERSITY AVERAGE
(After Evenson and Smith, 1958)

CEEB ACHIEVEMENT TEST	N_{CEEB}	Correlation With 1st Year Univ. Av.*		N_{Dept},	GRADE XII DEPT. SCORE
		r_{CEEB}	$r_{Dept.}$		
ADV. MATH	298	.41	.56	316	MATH. 31
INTERM. MATH.	178	.34	.45	609	MATH. 30
PHYSICS	235	.38	.58	484	PHYSICS 30
CHEMISTRY	182	.38	.56	614	CHEMISTRY 30
BIOLOGY	67	.26	.42	181	BIOLOGY 32
ENGLISH	136	.20	.24	613	ENGLISH 30
FRENCH	140	.29	.43	519	FRENCH 30
SAT - V	660	.27			
SAT - M	659	.30			

*Comparison Groups Differ

to the varying comparison groups, it appeared that Departmental marks consistently showed a higher correlation with university average than did the CEEB examinations. Evenson and Smith (1958) concluded that there was no evidence that would support the CEEB's replacing the comparable Departmental examinations in selecting university students in Alberta.

The 1956 Grade XII Survey gathered other information such as scores on SCAT, responses to a Student Questionnaire on educational and vocational plans, and a principal's rating for each student on such factors as initiative, industry, extracurricular activities, interests in further education, and overall prospects of university success. Analyses have been conducted on only a small part of this data (Evenson and Smith, 1958). The correlation between SCAT, Level 1, and university first year average (Table III) was very low and indicated that existing intelligence tests, as the ACE in the 1951 Study (Table I), are of little value in predicting university success. Results of the incomplete analyses of the Student Questionnaire and principal's ratings on the nine factors showed these measures to be of limited value (Evenson and Smith, 1958).

Black (1959, 1960) continued the analyses of data gathered in the 1956 Grade XII Survey. To compare Grade XII Departmentals with selected standardized tests used in the Subcommittee's study, 529 of the 1956 Grade XII class who took part in the special testing program and who entered the University of Alberta in 1956 were selected for study. The 1956 Study had provided scores for each student on two of

TABLE III

CORRELATIONS BETWEEN SCHOOL AND COLLEGE APTITUDE TEST AND UNIVERSITY FRESHMAN AVERAGE FOR 1956 GRADE XII SURVEY GROUP

(After Evenson and Smith, 1958)

PREDICTOR	N	CORRELATION WITH UNIVERSITY AVERAGE
SCAT - Verbal	616	.21
SCAT - Quantitative	616	.27
SCAT - Total	616	.29

seven CEEB tests, Scholastic Aptitude Test, Grade IX General Test, and SCAT (Level 1). The University Student Advisory Service provided scores on ACE Psychological Examination and two parts of the Co-operative English Test--Mechanics of Expression (Part A) and Reading Comprehension (Part C-2). As predictors of university first year average, these standardized tests ranked from best to poorest in the order of CEEB, SAT, SCAT, ACE, and Grade IX General Test (Black, 1959). No mention was made in this report of the relative effectiveness of the Co-operative English Test. Of the scholastic aptitude, or intelligence tests, the Scholastic Aptitude Test was most consistently the best predictor (Table IV), although even its median correlation with university average was a modest .35 (Table IV).

A disadvantage in the design of the 1956 Grade XII Survey was that each student wrote only two of the CEEB examinations with the result that comparison groups for each of the seven CEEB tests were different. Only limited comparisons could be made among the correlations derived by each of the CEEB tests with university average. Black (1959) in comparing each of the CEEB tests with the corresponding Departmental examination, compared the correlations derived for the same group of students for the two predictor variables. It was impossible, of course, to compare the CEEB average with the Departmental average for the same group of students since each student wrote only two CEEB tests. After comparing the respective correlations with university average for the individual CEEB tests and Departmentals for the same group of students, (Table V), Black (1959) found that Departmentals, with the exception of

TABLE IV

CORRELATION COEFFICIENTS BETWEEN FOUR ACADEMIC APTITUDE TEST SCORES AND UNIVERSITY FRESHMAN AVERAGE
(After Black, 1959)

	Sample writing part of CEEB Achievement Tests							Median r
	English	Biology	Chemistry	Physics	Intermediate Mathematics	Advanced Mathematics	French	
Test N =	119	49	144	179	184	246	116	
General Test (IX)	.182	.234	.250	.227	.197	.237	.248	.234
ACE - L	.234	.414	.347	.294	.274	.338	.208	.294
ACE - Q	.292	.234	.090	.176	.162	.191	.194	.191
SCAT - V	.167	.197	.298	.322	.245	.285	.263	.263
SCAT - Q	.425	.315	.262	.301	.145	.253	.307	.301
SAT - L	.123	.291	.319	.271	.230	.296	.275	.275
SAT - M	.381	.376	.253	.293	.185	.349	.348	.348

TABLE V

CORRELATIONS BETWEEN CEEB WITH UNIVERSITY AVERAGE AND GRADE XII DEPARTMENTALS WITH UNIVERSITY FRESHMAN AVERAGE

(After Black, 1959)

CEEB	N_{CEEB}	CORRELATION WITH UNIVERSITY AVERAGE		N_{Dept}	GRADE XII DEPT.
		r_{CEEB}	r_{Dept}		
ADV. MATH.	246	.408	.572	246	MATH. 31
INTER. MATH.	184	.281	.300	184	MATH. 30
PHYSICS	179	.400	.568	179	PHYSICS 30
CHEMISTRY	144	.402	.563	144	CHEMISTRY 30
BIOLOGY	49	.347	.552	49	BIOLOGY 32
ENGLISH	119	.194	.168	119	ENGLISH 30
FRENCH	116	.354	.470	116	FRENCH 30

English 30, consistently did a better job of predicting university average than did the corresponding CEEB test. Since each of the comparison groups for a subject area were the same in Black's study, the derived correlation coefficients varied somewhat from those found by Evenson and Smith (Table II) for the same predictor variables. More assurance could be placed on Black's findings of the relative superiority of Departmentals over CEEB examinations since he controlled many of the possible contaminators of correlation coefficients through his limited matching of groups of students.

Black (1960) and Zurowsky (1959) applied the technique of multiple correlation to compare combinations of the standardized tests used in the 1956 Grade XII Survey with combinations of Departmental marks. Black (1960) considered the criterion group as two groups--total university freshman sample (N = 529) and Engineering freshman (N = 131). Zero-order correlation coefficients betwean the variables and university average (Table VI) served to confirm the Departmentals' effectiveness as predictors. The three best single predictors, of those considered, were Departmental marks in Science, Mathematics, and Foreign Language for both of the criterion groups (Table VI). The differentiation of the criterion groups appeared to be worthwhile as evidenced by the noticeable difference in correlation coefficients between them. No doubt, criterion groups which did not share membership (Engineering freshmen were included in the All Faculties group) would have led to even greater differences in the relative effectiveness of predictors.

Following the technique developed by Horst (1954), Black (1960)

TABLE VI

CORRELATION BETWEEN UNIVERSITY AVERAGE AND SELECTED PREDICTOR VARIABLES FOR UNIVERSITY FRESHMEN FROM 1956 GRADE XII SURVEY

(After Black, 1960)

PREDICTOR VARIABLE*	CORRELATION WITH UNIVERSITY AVERAGE ALL FACULTIES N = 529	ENGINEERING N = 131
ENGLISH 30	.227	.303
SOCIAL STUDIES 30	.425	.420
GR. XII SCIENCES AV.	.632	.620
GR. XII MATH. AV.	.500	.598
FOR. LANGUAGE	.434	.482
SCAT - Verbal	.234	.266
SCAT - Quantitative	.276	.254
COOP ENG. MECHANICS	.235	.294
COOP ENG. READING COMP.	.192	.271
CEEB ADV. MATH.	-	.400
ACE - L	-	.361
ACE - Q	-	.245
SAT - V	-	.331
SAT - M	-	.356

* Partial List only

compared various combinations of predictor variables on the basis of multiple correlations. He found that a combination of the seven Grade XII examination scores required for admission to Engineering yielded as great a multiple correlation coefficient with freshman Engineering average ($R_7 = .686$) as the combination of twenty-five other predictor variables, the standardized tests described above with Grade IX Departmental results ($R_{25} = .687$) (Black, 1960, p.45). Of the six combinations of predictor variables he studied, Black concluded that "the five predictor variables of Group B (English 30, Social Studies 30, Mathematics Average, Science Average, and Foreign Language Average) were deemed the best operational combination for all the university course areas studied" (Black, 1960, p. 45). An important continuation of this study would seem to be to compare the predictive effectiveness of the Departmental results with that of a combination of Departmental results and a measure of scholastic aptitude (such as Scholastic Aptitude Test). The incomplete CEEB scores for the students did not appear to be compensated for in this study so that any combinations of predictor variables which included CEEB scores may have been subject to contaminating factors arising from difference of comparative groups.

The results of Zurowsky's (1959) study, which were included in the report made by Black (1960) were concerned with the relative predictive value of such variables as Grade IX Departmentals, Grade XII Departmentals, SCAT, Co-operative English Mechanics and Co-operative English Reading Comprehension with differential criteria--selected university science and business administration courses as well as

university average. The subjects in this study were the 529 members of the 1956 Grade XII Survey who entered the university in 1956.

Against the criterion of university average, the largest zero-order correlation of predictor variables was found to be that of Grade XII Science average ($r = .632$). The multiple correlation between a combination of the Grade XII battery, SCAT (V and Q), and the Co-operative English tests with the criterion of university average was 0.656 (Zurowsky, 1959, pp. 69-71). The actual improvement in correlation coefficients by using the entire battery of predictor variables rather than the best individual predictor, which was the Grade XII Science average for 9 of 10 criteria, was apparently not tested for significance although the researcher intended to study, among other implications from past studies, that "the use of multiple correlation promised a means of selecting the best combination of variables for predicting each criterion" (Zurowsky, 1959, p.46). The improvement, as indicated in Table VII, ranged from -.004 to .178 with a median improvement in correlation of .050. The generally slight improvement in correlation from using even all the predictor variables, as indicated in Table VII, would seem to provide some reason to doubt the implication above.

In comparing a battery of Grade XII Departmentals with a battery of SCAT subtests and Co-operative English tests combined, Zurowsky (1959) found that the Grade XII scores were the more effective predictors of university marks for nine individual courses and over-all average (Table VII). There was, generally, only slight improvement in the

TABLE VII

CORRELATIONS DERIVED FROM SEVERAL PREDICTOR VARIABLES WITH INDIVIDUAL UNIVERSITY COURSE MARKS AND FRESHMAN AVERAGE

(After Zurowsky, 1959; pp. 69-74)

UNIVERSITY COURSE--CRITERION	N	ZERO-ORDER CORRELATIONS			MULTIPLE CORRELATIONS			BEST R - BEST r
		MEDIAN r	BEST SINGLE PREDICTOR	BEST r	GR. XII BATTERY	SCAT COOP ENG.	ENTIRE BATTERY*	
CHEMISTRY 40, 42	336	.287	SCI XII AV.	.691	.698	.360	.704	.013
PHYSICS 40, 41	83	.260	SCI XII AV.	.702	.698	.324	.698	-.004
MATH. 1, 3, 4, 40, 45	137	.290	SCI XII AV.	.621	.653	.338	.696	.075
ACCOUNTING 1	31	.311	SCI XII AV.	.616	.655	.337	.741	.125
COMMERCIAL LAW 41	31	.245	SOC. ST. 30	.559	.604	.180	.713	.154
BOTANY 1, 5	65	.180	SCI XII AV.	.720	.720	.105	.741	.021
ZOOLOGY 1	127	.220	SCI XII AV.	.714	.715	.281	.717	.003
GEOLOGY 1	43	.159	SCI XII AV.	.492	.526	.336	.670	.178
GEOGRAPHY 1	46	.305	SCI XII AV.	.568	.608	.304	.713	.145
UNIVERSITY AVERAGE	529	.255	SCI XII AV.	.632	.656	.326	.658	.026

*Entire Battery - Grade IX Dept., Grade IX General Test
Grade IX Reading, Grade XII Departmentals
SCAT (V and Q), COOP English Tests

predictive ability of the entire battery of Grade IX and Grade XII Departmentals, SCAT and Co-operative English tests as compared to the predictive ability of a battery of five Grade XII Departmentals alone, although, again, no results of testing for significance of differences were included in the report.

Zurowsky analyzed the contributions of each of the predictor variables in the Grade XII battery by comparing their beta weights in each multiple regression equation. He concluded that the Grade XII Science average consistently contributed more weight than the other Grade XII subjects in predicting first-year university success. The Grade XII Foreign Language mark did not contribute to the prediction batteries (Zurowsky, 1959, p. 93).

Clarke (1958) reported two other studies that had been conducted at the University of Alberta. Fitzpatrick studied 253 freshmen enrolled in the Engineering faculty in 1954-55. He found that the best predictor of university average was the Departmental math-science average which yielded a correlation of 0.67. The ACE Psychological Examination yielded a correlation of only 0.23 with university average. Fair studied one hundred Arts freshmen who entered the university in 1953. He found that the correlation of the Departmental average with first-year university average was 0.64; the corresponding correlation for the ACE Psychological Examinations was 0.40. The relative superiority of Departmentals over the ACE was maintained in predicting the university third year average. The correlation coefficient using the Departmental average was 0.41 as compared to ACE's 0.31, but the best predictor of

third year average was the first year average which yielded a coefficient of 0.69 (Clarke, 1958).

A recent study by Mack (1963) of University of Alberta freshmen confirmed that the Grade XII Departmentals correlate more highly with university freshman average than do either the ACE Psychological Examinations or the Co-operative English tests. His results, related in part in Table VIII, were computed in terms of the faculty in which a student enrolled. Such differential criteria allowed more precise probability tables to be drawn up in the second part of the study (Mack, 1963, p. 108). The Grade XII average correlated most highly with marks of Faculty of Science students (r = .715) and lowest with Education students (r = .450), varying from a good predictor in the first instance to a mediocre predictor in the second. Mack also grouped the high school mean scores into units of five in order to present a concise table of probabilities of success in each faculty. Such a technique, developed by Eells (1961-a), would appear to be a valuable form of presentation of predictive data for guidance purposes. Mack's suggestion that his tables could be used by high school students with their counsellors would seem to be limited by the nature of the data, Departmental marks, which are not available until after the school term has ended.

Implications Arising from Alberta Studies

1. Of the many types of predictors of university success considered in Alberta to date, the most valuable one has been the results

TABLE VIII

CORRELATIONS BETWEEN SELECTED PREDICTOR VARIABLES AND UNIVERSITY AVERAGE FOR 1960-61 UNIVERSITY FRESHMAN CLASS
(After Mack, 1963)

GROUP	CORRELATION WITH UNIVERSITY AVERAGE					
	H.S. AVERAGE	ACE - Q	ACE - L	ACE - T	CO-OP, A	CO-OP, C_2
ARTS FACULTY	.508	.155	.253	.260	.379	.321
SCIENCE FACULTY	.715	.297	.282	.325	.384	.298
EDUCATION FACULTY	.450	.084	.195	.174	.193	.219
ENGINEERING FACULTY	.549	.234	.243	.272	.151	.280
OTHER FACULTIES	.647	.130	.389	.354	.446	.390
MDN. r	.549	.155	.253	.272	.379	.298

of Grade XII Departmental Examinations. As shown in Table IX, Grade XII marks have been found to be superior to Grade IX results, standard achievement test scores, and scholastic aptitude tests.

2. In studies of multiple prediction, the Grade XII battery has been found to be superior to batteries of any other predictor variables. Very little improvement resulted from adding scholastic aptitude test scores or results from standard achievement tests to the Grade XII battery. Improvement in the prediction of success at the University of Alberta would appear to be found through improved methods of measuring achievement in Grade XII.

3. Either the Grade XII average or Grade XII course marks were used in past studies. There was some indication that the use of course marks allowed the best discriminators, for example, the science average, to be given more weighting than poorer predictors. There appeared to be a need to test the relative merits of Grade XII average as compared to Grade XII course marks in their ability to predict university success.

4. Recent studies in Alberta considered differential criterion groups at the university. Such differentiation appeared to offer the promise of improved predictive accuracy as compared to considering students as one group.

5. As valid predictors are found, a problem of communicating the results to high school students and counsellors has developed. The techniques employed by Mack (1963) of using an expectancy chart would seem to be worthwhile. There was some indication that the regression equation appeared to be too complex a technique for current general

TABLE IX

SUMMARY OF RESULTS OF ALBERTA STUDIES OF CORRELATIONS BETWEEN UNIVERSITY AVERAGE AND SELECTED PREDICTOR VARIABLES

INVESTIGATOR	TYPE OF STUDENT	PREDICTOR VARIABLES				TYPE OF SCH. APT.
		GRADE IX DEPT.	GRADE XII DEPT.	STAND. ACHIEV.	SCH. APT.	
EVENSON & SMITH (1958)	1951 Freshmen	.40	.48	-	.36	ACE-T
	1953 3rd Yr. Grad.	.42	.36	-	.16	ACE-T
	1954 4th Yr. Grad.	.25	.50	-	.18	ACE-T
FAIR (CLARKE, 1958)	1953 Arts Freshmen N = 100	-	.64	-	.40	ACE-T
	1955 Arts 3rd. Yr.	-	.41	-	.31	ACE-T
FITZPATRICK (CLARKE, 1958)	1954 Engin. Freshmen N = 253	-	.58	-	.23	ACE-T
EVENSON & SMITH (1958)	1956 Freshmen	-	.45$^+$	.30^{+1}	.29	SCAT-T
BLACK (1959)	1956 Freshmen	-	.55$^+$	.35^{+1}	-	
(1960)	1956 Freshmen	-	.43$^+$	.24^1	.28	SCAT-Q
	1956 Eng. Freshmen N = 131	-	.48$^+$	.29^2	.36	ACE-L
ZUROWSKY	1956 Freshmen N = 529	.20$^+$	.66*	.24^2	.25$^+$	SCAT
MACK (1963)	1960 Arts Freshmen	-	.51	.38^2	.26	ACE-T
	Science	-	.72	.38^2	.33	ACE-T
	Educ.	-	.45	.19^2	.17	ACE-T
	Engin.	-	.55	.15^2	.27	ACE-T
	Other	-	.65	.45^2	.35	ACE-T

$^+$Median Correlation Coefficient

*Multiple Correlation Coefficient

^{1}CEEB Examinations

^{2}COOP ENGLISH MECHANICS

school usage even though the graphic interpretation of multiple prediction equation scores proposed by Black (1960) offers a better interpretative technique for multiple-variable predictive data.

High School Achievement and University Success

Since one measure of high school achievement, the Grade XII Departmentals, has been found to be a better predictor of university success in Alberta than standard achievement or scholastic aptitude tests, it appeared to be worthwhile to investigate the predictive validity of other measures of high school achievement. Studies in Canada and the United States have been concerned with such predictor variables as rank-in-class, teachers' ratings on character traits, and counsellors' predictions, and with improving the predictive value of present measures.

In his review of predictive studies, Henry (1950) suggested that there is a ceiling on the correlation between high school marks and university average because of the nature of the high school mark. He explained that even if several students achieved the same mark at the same high school, or on the same set of examinations, there may be great differences among the ways in which this mark was achieved, and hence, the students' chances for future scholastic success. One student might have only mediocre mental ability but through efficient study habits and many hours of work does well in school work. Another student might be much more intelligent but is inefficient and disinterested in studying. A third student might be both quite intelligent and a reasonably

conscientious worker. Consideration of the mark alone probably ignores much of the relationship between scholastic ability and work habits--a relationship which migh well determine the chances of later success.

Attempts to overcome shortcomings in the high school marks were made in a number of ways. Williams and Knecht (1962) postulated that since the teacher and student were closely acquainted for a comparatively long period of time, a rating by the teacher might consider many factors that are relevant in prediction problems. In their study, teachers were asked to rate each of their students on "likability". The correlation between their rating and the California Test of Mental Maturity was fairly high ($r = .53$) but the correlation between rating and high school grade point average was higher ($r = .71$). Thus, the rating of even a non-intellective trait corresponded well with scholastic success and scholastic aptitude.

Black's study (1958) in Alberta made a similar finding about teachers' ratings. In both Grade IX and Grade XII, a rating is made by teachers for each student in each subject area prior to the Departmental Examination. These reports are collected together for the students of each school in the form of a Principal's Confidential Report. For a sample of about six hundred Grade IX students, the median correlation between the teachers' ratings and Departmental marks was 0.65. It was found, however, that SCAT scores correlated higher with the Departmental mark (median $r = .80$). Thus, in Grade IX, teachers' ratings were of value in predicting subsequent Departmental marks but were second in size to the SCAT scores.

A study by Bou and Stovell (1950) intended to find the predictive value of teacher-assigned high school marks. A regression equation was computed for the total group of students predicting university success from high school marks. On the rationale that the number of students with whom a teacher was associated would determine the validity of the assigned marks, the high schools were divided into two groups--"small high schools" with less than five hundred students and "large high schools" with five hundred or more students. A comparison was made between the two sizes of high schools on the average difference between predicted score, arising from an application of the regression equation to teachers' marks, and the actual score attained at university. The large high schools had a smaller average difference between these two scores than the small schools. The predicted value for students of small schools was generally an overestimation. It should be noted that the differences between the two groups was somewhat spurious in that each of the small high schools had, of course, fewer members in the freshman class with the result that a "miss" on just one or two students would have a sizable effect on the mean. It would have been interesting, too, to have a further breakdown into groups of schools. Size of school would seem to be an important factor to consider in the use of teachers' ratings.

Prescott and Garretson (1940) found that correlations between university freshman success and teachers' ratings on student characteristics were greater than 0.60 for such characteristics as habits of studiousness, probable success at university, persistence, and ability to budget time. The teachers' ratings of probable success at university

correctly predicted 79 per cent of those with passing grades and 69 per cent of failing students at university. These findings were, however, based on three hundred students from one high school so that little generalization of the findings could be made.

Robertson (1960) conducted a study to determine the relative merits of a counsellor's and a student's prediction of college success. At a pre-college program, prospective freshmen were asked to predict their success at university (pre-estimate). Following two days of testing, each student met with a counsellor who interpreted the test results. Each student made a second prediction (post-estimate) and the counsellor made his own prediction. Using the first semester grades as the criterion, only the counsellor's estimate was relatively valuable ($r = 0.50$). It was found that students tended to overestimate their abilities; the counsellor overestimated for the low-achieving students. Although these estimates were of limited value individually, Robinson suggested that they might contribute to a battery of high school grades and intelligence scores. Such a specialized program would seem to be of limited practical utility, especially if correlations of prediction with university success are low, because of the expense and proximity in time to the start of university program.

An Ontario study of the entire population of Grade XIII graduates included provisions for the evaluation of teachers' ratings (Jackson and Fleming, 1957). A staff questionnaire, completed by each student's teachers, included a five-point rating sclae regarding such factors as leadership, industry, and chances of success at university. An

acknowledged weakness was the variability in each rater's interpretations of the terms. Of all the Grade XII graduates, some fifty-three per cent were rated as higher than average regarding chance of university success. A follow-up study showed that seventy-three per cent of these students actually enrolled in university. To date, no reports have been issued on actual performance in university of this group.

Douglas's study (Garrett, 1949) at the University of Oregon involved the use of the "Principal's Quartile Rating" of scholarship. Although this rating correlated only moderately well with university success ($r = .48$), it was second only to actual high school average ($r = 0.56$). By combining the rating with rank-in-class, a correlation of 0.50 with university freshman marks was derived. Adding the rating to the high school average did little to improve the predictive power.

Pherson (1958) conducted a study in Portland, Oregon to investigate the success with which high school teachers and counsellors predicted university success. One month before high school graduation, the teachers and counsellors rated each student on personality traits and general ability to do university work. The predictive success of these ratings for some two hundred randomly-chosen freshmen was compared to the predictive success of such variables as high school grades and the ACE Psychological Examination. The ratings on personality traits did not prove to be consistently successful. The ratings on general ability correlated with college grades to the same degree that the ACE did. Each of these variables was less successful than high school grades which had a correlation coefficient of 0.65.

McGill University, concerned with the unreliability and unknown validity of entrance marks, has made use of confidential reports from each applicant's school (Matthews, 1957). No statistical study has been conducted regarding the success of this practice. Two immediate problems of the scheme were the varying standards from school to school and the limitations on counselling, arising from the confidential nature of the rating.

Predictive studies have been limited by the unknown reliability and validity inherent in instructor's marks. A study by Carter (1953) investigated the hypothesis that teachers' marks are affected by such non-intellective variables as subjective preference of one group of students as a result of teacher identification with that group. He suggested that the sex of the student as compared to the sex of the teacher might be such a factor. In his study, which also considered the effect of pupil differences in socio-economic status and personality, some two hundred high school students were selected. Each student was taught and tested by one of six experienced teachers in an algebra course. The sexes were evenly represented in both student and teacher groups. The teacher-assigned marks were compared to scores on the algebra test from the California Achievement Test battery. There was a high correlation between the two sets of marks but it was found that, regardless of whether the teacher was male or female, boys were penalized in the ratings. Negative non-intellective factors tended to be more influential with males than with females.

The composition of instructor's marks being somewhat different for

female students than for males was suggested as one cause for the apparent predictive superiority of marks for female students that was found by several researchers (Seashore, 1962; Klugh, et. al., 1959; Abelson, 1952). The study by Klugh which considered the correlations between high school and college grade point averages, found that the correlation for the female group was significantly greater than that of the male group in both an original study ($r_f = .65$; $r_m = .58$) and a cross-validational study ($r_f = .68$; $r_m = .53$).

Despite their better correlation with university grades, the marks of female students were generally found to be less variable than those of male students. Abelson (1952) combined this finding with the finding that marks for females had greater predictive success to investigate the reality of the difference. Using a statistic termed the "standard error of prediction" which represented the difference between predicted and observed college scores (similar to standard error of estimate), Abelson found a significant difference in all studies including those for which the correlation coefficients for female students were not larger than those for males. Since the standard error of prediction is dependent on the standard deviation of college scores and the correlation between predictor and college grades, it would appear to be an appropriate measure of sex differences in predictor studies.

Seashore's (1962) review found that approximately 80 per cent of the predictive studies showed that the correlation coefficient was larger for female students than for males; a similar proportion showed that marks for female students were less variable than those of males. In

attempting to explain this apparent sex difference, Seashore raised several questions including the possibility, mentioned above, that more extraneous r-reducing variables entered the teacher's judgment in giving grades to men. He suggested that a male group is more likely to have a few "maverick" performers who act in a virtually unpredictable way. There was a common belief, still not strongly supported by research studies, that more boys than girls tend to be under-achievers in high school. Coupled with this difference is the difference in motivation for males between high school and university. In addition, college men tend to have more outside interests than college women. Such outside interests have a generally unpredictable effect on college grades. The difference between the variability and predictive success of female students' marks as compared to those of male students has been fairly well founded but not well explained.

The use of teacher's grades offered the obvious problem of taking into account the variations among schools and educational programs. Attempts have been made to compensate for differences between ratings since it is generally felt that "the best available evidence of a student's academic capabilities and achievements consists of the judgments made by the teachers and professors who have worked with him over a period of years" (Bloom and Peters, 1961, p. 3).

One such attempt was made by Bou and Stovell (1950) who found that more precise predictions could be made by differentiating students into two groups on the basis of the size of high school from which they graduated.

Yale and Princeton Universities have attempted to improve the prediction from high school grades by yearly codification for each school regarding the success of its graduates. Respectable correlations (r = 0.76) were found with marks from schools which sent many graduates but not with those of schools which sent few graduates (Bloom and Peters, 1961, p. 8).

British studies have used a "transmutation of marks" that takes into account the difference in intelligence level of various student populations (Bloom and Peters, 1961, p. 16). Teachers' marks were scaled on the basis of the school mean and standard deviation of scores made on a common intelligence test. The scaled score became the best single predictor of university success.

A further complexity, not yet considered in any published Alberta studies occurs when the criterion scores originate in more than one university or other post-secondary school institution. A local example would be to predict, with scores from Alberta high schools, the students' chances of success at either branch of the University of Alberta, at junior colleges, and at technological institutes. Bloom and Peters (1961, p. 49) arrived at a method of scaling high school and college scores in such a way that scores which yielded a maximum correlation of 0.51 with university grades were corrected to yield a correlation of 0.77. Briefly, the correcting process consisted of equating the college marks from one institution to another, from which an adjusted mark was found for each high school. The adjusted mark was correlated with the actual college mark, giving a regression equation for each college. The resulting values

were used to adjust the student's college mark. The same adjustments were used with a following year's class and the correlation remained relatively high (r = 0.72). Despite the time-consuming manipulations and complexity, this approach seemed to suggest a means of answering a problem soon to be faced in Alberta.

Another recent statistical development which may improve the prediction of college success was the technique of multiple differential grade prediction. This technique allows the researcher to choose the best combination from a large pool of predictive variables for each college area. There have been differences of opinion as to the value and wisdom of using such a technique.

Differentiating among the criteria has met with some success. To test the varying efficiency of predictors, researchers at Yale computed the correlation between SAT Verbal scores and freshman marks in several subjects (Bloom and Peters, 1961; p. 28). The SAT score was a fairly good predictor of English-history (r = 0.49) and physics marks (r = 0.40) but a poor predictor of Engineering drawing. Zurowsky (1959), as mentioned above, found that although the high school science mark was a valuable predictor for each of the university courses considered, the contributions of the other high school subjects varied among the criteria. Mack (1963) found that the predictive value of the high school average varied considerably among the faculties.

Travers (1958) felt that the multiple prediction method was often used in a "shot-gun" approach, whereby the researcher grasps at anything that has apparent "predictive validity" without the benefit of a

theoretical framework. Since some of the correlation may be due to chance factors arising from the particular sample group, the researcher may be misled into believing he has found a valuable predictor. Travers recounted that many such predictors have "shrunk" to the point of being worthless in cross-validational studies in which the irrelevant chance factors were no longer present (Travers, 1958, p. 300). Conversely, the University of Washington group under Dvorak and Horst, have taken the position that use should be made of all variables readily available to the admitting officers of the university even though its actual contribution to the prediction is slight. Such a position is premised on the availability of computer facilities.

One multiple prediction technique is the Horst iteration method which "selected only those predictor variables in an assigned weighting for each so as to produce the largest multiple correlation coefficient possible between the criterion and the predictor variables" (Black, 1960, p. 41). In Black's study of 1956 freshmen, it was found that the increases in correlation coefficients through use of a combination of predictors instead of the single best predictor ranged from 0.00 to 0.14, with a median increase of 0.03. No tests of significance of the increases were reported but one could conclude that the multiple correlation coefficient tended to be consistently, but modestly, greater than the zero-order correlation coefficient for the best predictor.

The study of Klugh and Bierley (1959) investigated the improvement in predicting university grade point average by two variables, high school average and SCAT scores, instead of the high school average alone.

As indicated on Table X, the multiple correlation method did result in an increase for both men and women students in studies a year apart. The increase in each case was found to be significant.

Not all researchers agree that multiple predictive grade correlation studies are worth the extra effort. Eells (1961) found that combining standardized test scores together in differential batteries for each of four curricula areas in university resulted in little improvement in predictive accuracy. It appeared that accurate results could be achieved through the use of one battery for all curricula areas. Since high school records were not considered in the battery, no sound conclusions could be made about the value of differentiating among the criteria in studies employing high school marks.

The complexity of factors affecting the predictive accuracy of high school marks was illustrated by Fleming's comment, that:

> ...in theory, it should be possible to predict with a high degree of accuracy from the Grade XIII average alone what university average will be obtained by a girl of 17 or 18 who does some of her Grade XIII work in Grade XII, who writes all the rest of her Grade XIII papers in the succeeding year without failure, who comes from a school with a favourable environment in a community of high economic level, who lives at home while attending university, and who enters an Honours Course (Clarke, 1958, p. 36).

Perhaps the single most important feature in limiting the effectiveness of various predictors alone and in combination lies in the reliability of criterion scores, namely, university grades. This aspect of the problem to a large extent has been ignored probably because of the difficulty in obtaining such information and the embarrassment resulting from it. The English "transmutation" of criterion scores cited

TABLE X

ZERO-ORDER AND MULTIPLE CORRELATION COEFFICIENTS
BETWEEN SCAT SCORES, HIGH SCHOOL AVERAGE AND
UNIVERSITY FRESHMAN ACHIEVEMENT
(After Klugh and Bierley, 1959)

GROUP	N	CORRELATION BETWEEN COLLEGE AVERAGE AND A SCAT	 B H.S. AVERAGE	 MULTIPLE A + B
1956 MEN	106	.54	.58	.67
WOMEN	97	.51	.65	.68
1957 MEN	125	.59	.53	.66
WOMEN	102	.67	.68	.78

by Bloom and Peters (1961, p. 6) and referred to earlier recognizes this problem in part but it has been largely ignored in the North American studies.

Summary

A consistent finding in past studies was that the best predictor of university freshman success was some measure of high school achievement (Bloom and Peters, 1961; Garrett, 1949; Henry, 1950; and Travers, 1949). High school marks were found to be more valid as predictors than such other variables as standardized achievement tests, scholastic aptitude or intelligence tests, and existing measures of persistence and motivation. The superiority of high school marks in predicting first-year success at the University of Alberta has been confirmed by many studies (Black, 1959, 1960; Clarke, 1958; Evenson and Smith, 1958; Mack, 1963; and Zurowsky, 1959). The measure of high school achievement considered in past Alberta studies was the Grade XII Departmental Examination (Table IX).

The best predictor of marks in the graduating year at the University of Alberta have been found to be the university average of previous years (Evenson and Smith, 1958).

The predictive accuracy of high school marks was found to be influenced by the size of high school at which the marks were assigned (Bloom and Peters, 1961; Bou and Stovell, 1950). Marks of students from large high schools, where the comparison groups were more normally distributed, produced greater correlations with university achievement

than marks of students from small high schools produced.

The technique of multiple differential grade prediction was found to provide a method of improving the predictive efficiency of presently-available variables (Black, 1960; Horst, 1954; Mack, 1963; and Zurowsky, 1959). This approach assumes both that predictor variables will vary in their correlation with a criterion and that this relative value of predictor variables will change from one criterion to another. Each of the Grade XII Departmental Examinations has been found to have a correlation with university freshman average. The multiple correlation between a battery composed of the Departmental Examinations and university average was found to be greater than the zero-order correlation between the single best predictor of the Departmentals and university average (Table VII). Improved predictions of university success were achieved by differentiating among the criteria, generally on the basis of university faculty or individual course.

In addition to the graduating high school size and the faculty entered at university, the sex of the student was found to have an effect on the predictive accuracy of high school marks. The marks for female students were found to be predictively superior to the marks of male students (Abelson, 1952; Klugh et. al., 1959; and Seashore, 1962). In addition, there was some indication that male students were penalized by teacher-assigned marks (Carter, 1953).

Several studies (Garrett, 1949; Jackson and Fleming, 1957; Pherson, 1958; and Prescott and Garretson, 1940) reported that a teacher's rating was found to be a valuable predictor of future academic

success because it contains some information not considered in a test score. Henry (1950) suggested that the teacher's rating would consider the interplay of ability level and work habits more than the test score alone would. The value of teachers' ratings were attributed to the general teacher-student association in past learning situations and, as such, were relevant predictors of future learning (Williams and Knecht, 1962; Bloom and Peters, 1961).

CHAPTER III

EXPERIMENTAL DESIGN

Hypotheses

The present study investigated the problem of predicting success at the University of Alberta, Edmonton. Research findings indicated that the factors of size of high school, faculty in which a student enrolled, and sex of the student would affect the accuracy of predictors. Past studies also indicated that teachers' ratings of high school performance were valuable predictors of university freshman success.

1. The predictive accuracy of high school marks, as indicated by their correlation with university average, is affected by the size of high school at which the marks were assigned. Marks of students from larger high schools would produce greater correlations with university average than would marks of students from smaller high schools (Bloom and Peters, 1961; Bou and Stovell, 1950).

2. The value of a predictor variable or ideal composition of a predictor battery varies from one faculty group to another. The relative value of a variable in a battery varies according to the faculty in which the student enrols (Black, 1960; Horst, 1954; Mack, 1963; and Zurowsky, 1959).

3. High school and university scores and the correlation between them differ for male and female groups of students. The correlation between high school marks and university average is greater for female

students (Abelson, 1952; Klugh et. al., 1959; and Seashore, 1962). Predictions of marks for male students are more likely to be underestimations of the actual mark than predictions for female students (Carter, 1953).

4. The use of Grade XII Principals' Ratings would lead to as great a correlation with university first-year average as would the use of Grade XII Departmental Examinations. Despite their unknown reliability, the teacher's rating was found to be a valuable predictor of future academic success because of its basis on a relatively long-term association between student and teacher in learning experiences (Bloom and Peters, 1961; Garrett, 1949; Henry, 1950: Jackson and Fleming, 1957; Pherson, 1958; Prescott and Garretson, 1940; and Williams and Knecht, 1962).

The Sample

The sample consisted of members of the 1962-63 freshman class at the University of Alberta, Edmonton, who had enrolled in the faculties of Arts, Education, Engineering, and Science. Only those freshmen were selected who had completed the Grade XII course of studies in Alberta in June, 1962, and for whom all Principals' Ratings were available. The sample consisted of 1017 freshmen, 457 of whom were female and 560 of whom were male.

The Procedure

A data sheet was made for each freshman in the sample. From the Registrar's Office, University of Alberta, such data as final course marks

in first-year subjects, university first-year average, sex of student, and faculty entered were recorded on the form. The Grade XII Departmental Examination results, the name of graduating high school, the number of teachers in the graduating high school, and the ratings given in the Principals' Confidential Report were gathered for each student from the Examination Branch, Department of Education.

There were a minimum of six Grade XII high school marks for each student. The marks in the sciences, two or three of Physics 30, Chemistry 30, and Biology 32, were combined by recording the mean score as Science Average following the procedure of Zurowsky (1959). Each student in the Faculty of Engineering, as well as many others in the sample, had high school marks in Mathematics 31 as well as in Mathematics 30. The mean was derived for these students and recorded as the Mathematics Average. For students who had marks in more than one Grade XII foreign language, usually French and Latin, the marks were averaged and recorded under Foreign Language. In addition to the areas of science, mathematics, and foreign language, there were marks for each student in Social Studies 30 and English 30 (Language 30 and Literature 30). Any student for whom both Principals' Ratings and Departmental Examination results were not available for each of these five subject areas was not considered in the study.

The total data from each sheet was punched on to a deck of IBM master cards. Input cards for the computer were made by drawing appropriate data from the master cards.

Statistical Analysis

The basic analysis was conducted at the Computing Center, University of Alberta by the Stepwise Regression program (1963) in accordance with the stated hypotheses of the present study. This program derives the means and variances of the predictor variables and the criterion, the intercorrelation matrix, the multiple correlation coefficient between various combinations of predictor variables with the criterion, and the multiple regression equations.

The differences between means were tested for significance by the conventional t-test. Significance of differences between variances was tested by a conventional F-test. The accepted levels of significance were considered to be .05 and .01 as indicated on the tables.

The score weights of each of the predictor variables in the regression equations were compared on the basis of a transformed Beta weight in which:

$$\beta = \frac{s_p}{s_c} b$$

where β is the relative beta weight
s_p and s_c are the standard deviations of the predictor and criterion variables,
b is the score weighting from the computer output for the predictor variable.

The significance of differences between the multiple correlation coefficients was tested by the z-test in which:

$$z = \frac{z_{R_1} - z_{R_2}}{\sqrt{\frac{1}{N_1 - 3} + \frac{1}{N_2 - 3}}}$$

where Z_{R_1} and Z_{R_2} are the Fisher's transformations of the multiple correlation coefficients and the denominator represents the standard error of difference between the two z's.

The levels of alpha error less than .05 and less than .01 were considered as indicating significance.

CHAPTER IV

THE EFFECT OF SCHOOL SIZE ON PREDICTION OF FRESHMAN SUCCESS

Earlier studies have found that the amount of success in using high school marks to predict university success was related to the size of high school from which a student graduated. The marks from larger schools have been shown, generally, to be the more valid predictors (Bou and Stovell, 1950; Bloom and Peters, 1961).

To test the hypothesis that marks of students from larger high schools would be better predictors of academic success at the University of Alberta than marks of students from smaller high schools, the data was grouped on the basis of size of high school from which the student graduated. The criterion used to determine the size of school was the number of teachers on the high school staff. The faculty sizes of the high schools, for the sample of students considered in the present study, ranged from three to seventy-five teachers. The number of staff in each high school was determined from a listing of "Approved Secondary Schools in Alberta," published yearly by the Department of Education from school statistics submitted in the fall.

To facilitate an examination of the effect of school size the schools were grouped into seven categories, as shown on Table XI. The means and standard deviations of the predictor and criterion variables were computed and tabulated for each of the seven school-size categories. The multiple correlation between the predictor variables and the criterion, first-year university average, and the relative contributions of each of

TABLE XI

NUMBER OF FRESHMEN FROM HIGH SCHOOLS OF VARYING SIZE AS DETERMINED BY NUMBER OF TEACHERS

SCHOOL SIZE CATEGORY	NUMBER OF TEACHERS	SAMPLE SIZE N
1	1 - 5	101
2	6 - 10	204
3	11 - 15	109
4	16 - 20	115
5	21 - 25	88
6	26 - 50	187
7	51 - 75	213

TABLE XII
MEANS AND STANDARD DEVIATIONS OF DEPARTMENTAL MARKS AND PRINCIPAL RATINGS AND UNIVERSITY AVERAGE OF STUDY SAMPLE BY SIZE OF SCHOOL

SCHOOL SIZE	N	ENGLISH 30 $\bar{X}$	ENGLISH 30 S	SOC. STUD. 30 $\bar{X}$	SOC. STUD. 30 S	MATH. AV. $\bar{X}$	MATH. AV. S	SCIENCE AV. $\bar{X}$	SCIENCE AV. S	FOR. LANG. $\bar{X}$	FOR. LANG. S	UNIV. AV. $\bar{X}$	UNIV. AV. S
DEPARTMENTAL MARKS													
1	101	68.60	10.64	67.51	9.96	64.81	10.10	68.10	7.43	68.84	10.47	60.61	7.96
2	204	67.68	9.88	69.00	8.81	65.91	10.51	68.59	8.39	66.26	10.00	59.37	9.37
3	109	68.61	10.35	70.17	9.96	68.35	11.07	69.72	8.77	69.65	10.42	59.99	9.53
4	115	70.70	10.23	69.51	10.51	68.43	10.98	69.39	10.07	72.59	11.11	60.55	9.86
5	88	68.82	9.91	70.69	11.38	66.27	10.58	69.80	8.59	67.61	11.96	59.95	10.75
6	187	70.28	10.74	70.98	10.09	69.20	12.63	71.75	10.06	68.95	12.83	63.01	11.07
7	213	71.06	10.66	72.91	9.77	68.57	11.44	69.62	10.05	71.72	11.45	61.53	11.50
Total	1017	69.50	10.42	70.30	10.27	67.48	11.47	69.59	9.54	69.29	11.73	60.84	10.33
PRINCIPALS' RATINGS													
1	101	68.32	10.59	70.72	10.33	67.49	10.75	70.38	8.02	67.61	12.80		
2	204	65.02	9.06	67.70	9.75	66.16	12.00	67.83	8.81	63.78	10.73		
3	109	67.98	9.55	70.11	10.53	68.03	11.81	68.65	8.88	63.70	14.50		
4	115	67.22	8.96	68.96	10.08	65.91	12.00	67.50	10.51	66.87	13.10		
5	88	67.33	9.25	71.82	10.34	67.72	13.62	67.89	10.28	64.66	13.82		
6	187	67.67	11.30	69.87	10.77	68.18	12.46	68.53	11.21	65.96	13.96		
7	213	68.22	9.98	71.74	11.26	65.02	13.38	65.97	11.04	68.10	13.11		
Total	1017	67.27	9.95	69.87	11.01	66.62	12.75	67.76	10.51	65.78	13.40		

TABLE XIII

MULTIPLE CORRELATION COEFFICIENTS BETWEEN PREDICTOR VARIABLES AND UNIVERSITY AVERAGE FOR VARIOUS SCHOOL-SIZE GROUPS

SIZE OF SCH. CATEGORY	N	DEPARTMENTAL		PRINCIPAL RATING	
		R_D	SE_{est}	R_{PR}	SE_{est}
1	101	.643	6.26	.643	6.25
2	204	.567	7.81	.576	7.76
3	109	.586	8.24	.516	8.71
4	115	.570	8.29	.614	7.96
5	88	.585	8.98	.501	9.58
6	187	.721	7.78	.672	8.31
7	213	.766	7.48	.728	7.98
TOTAL	1017	.636	7.99	.605	8.24

the predictor variables in the regression equations were also determined for each group.

Ranking of the means for predictor and criterion variables from the data shown in Table XII, indicates that Departmental marks of students from large schools, school-size categories 6 and 7, consistently ranked in the highest three. There was a tendency for the variation in marks, as indicated by the standard deviation, to be greater for students from the two largest sizes of school. A similar pattern existed within the Principals' Ratings.

The size of the multiple correlation coefficients, reported in Table XIII, divided the seven categories of schools into two distinct groups. The large schools, i.e., categories 6 and 7 or schools with more than twenty-five teachers on staff, had multiple correlation coefficients of .721 and .766 compared to those of smaller schools which ranged from .567 to .643 when the Departmental scores were used to predict freshman success. The same pattern exists when Principals' Ratings are used although the dichotomy is not as pronounced, the large school multiple correlation coefficients being .672 and .782 compared to coefficients ranging from .501 to .643 for small schools.

The high school marks of the two largest school-size categories were similar in both their higher predictive value with university success and their comparatively larger means and standard deviations. On this basis, the seven categories of school sizes were reduced to two. Categories one to five were combined into a "small high school" group, schools having up to 25 teachers, for the purpose of further analysis.

Schools in categories 6 and 7, having 26 to 75 teachers, were categorized as "large high schools." This division of school sizes appeared to be compatible with that of Bou and Stovell (1950) who grouped schools into large and small categories on the basis of size of student body--small schools had less than 500 students, large schools had 500 and over.

The data for students from each of these two new school-size groups were considered separately and means, standard deviations, and multiple correlation coefficients were calculated for these two categories. These statistics are reported in Tables XIV and XV.

Table XIV shows that the mean scores and the standard deviations tended to be greater for the large high school group than for the small school group. The differences between the mean scores of the two school-size groups were statistically significant for all of the predictor variables in the Departmental battery; the differences were significant for only the Social Studies and Foreign Language variables in the Principals' Rating battery. Thus, although students of large high schools actually received higher marks in the Departmentals, their Principals' Ratings were not significantly greater for all of the variables. The variances of scores in the large high school group tended to be greater than the variances of small school scores for both the Departmentals and the Principals' Ratings (Table XIV). The university average was both greater and more variable for students from large high schools as compared to those from small schools.

The marks from larger schools, both Departmentals and Principals' Ratings, were consistently better predictors of university success than

TABLE XIV

MEANS AND STANDARD DEVIATIONS OF DEPARTMENTAL AND PRINCIPALS' RATING MARKS AND UNIVERSITY AVERAGE FOR TWO SCHOOL-SIZE GROUPS

VARIABLE		SCHOOL SIZE				SIGNIFICANCE OF DIFFERENCE	
		SMALL N = 617		LARGE N = 400			
		$\overline{X}$	s	$\overline{X}$	s	$\overline{X}$	s
English 30	Dept.	68.72	10.18	70.70	10.69	.01	NSD
	P.R.	68.82	9.49	67.96	10.61	NSD	.01
Social Studies 30	Dept.	69.30	9.94	72.01	9.95	.05	NSD
	P.R.	69.44	10.21	70.86	11.06	.05	.05
Mathematics Average	Dept.	66.68	10.70	68.87	12.00	.01	.05
	P.R.	66.88	12.01	66.50	13.03	NSD	.05
Science Average	Dept.	69.03	8.68	70.61	10.10	.05	.01
	P.R.	68.34	9.28	67.17	11.18	NSD	.01
Foreign Language	Dept.	68.66	10.86	70.42	12.43	.01	.05
	P.R.	65.09	12.75	67.10	13.54	.05	NSD
University Average		59.95	9.54	62.22	11.31	.01	.01

TABLE XV

MULTIPLE CORRELATION COEFFICIENTS BETWEEN PREDICTOR VARIABLES AND UNIVERSITY AVERAGE FOR TWO SCHOOL-SIZE GROUPS

MARK	SCHOOL SIZE				SIG. OF DIFF.
	SMALL N = 617		LARGE N = 400		
	R_S	SE_{est}	R_L	SE_{est}	$R_S - R_L$
Departmental	.560	7.93	.735	7.71	.01
Principal Rating	.558	7.95	.697	8.16	.01

the marks from smaller schools (Table XV). The comparison of correlation coefficients between high school marks and university average indicated that the superiority of marks from the larger schools to predict freshman success was significant at the .01 level.

On the basis of the above evidence, it was felt worthwhile to maintain the differentiation between students from the two larger school-size groups. The first hypothesis of this study, that the correlation between high school marks and university average would be greater for students from larger high schools than those from smaller schools, was substantiated as well.

An examination of the relative beta weights, which were derived from the score weights obtained from the computer, revealed that the Science Average was consistently the greatest contributor to the predictive battery (Table XVI). For students of small high schools, the Mathematics Average made a negative contribution to the battery. For students of large schools, the smallest contribution to the battery was that of the Social Studies 30 mark. The comparison of relative beta weights served to further justify differentiating students on the basis of having attended high schools of the two size categories.

In summary, the development of separate regression equations based upon school-size groups was felt to be justified because there were real differences among these groups in the performance on predictor and criterion variables, in the multiple correlation coefficients between high school marks and university freshman average, and in the beta weights of individual predictors in the battery. The differentiation on the basis

of two school sizes, then, was found to be as effective as the differentiation among seven size categories. This two school-size categorization, small high schools consisting of schools with 25 or less teachers and large high schools with more than 25 teachers, was adopted as the basis of classification of data relating to school size and was used for the remainder of the analyses in this study.

TABLE XVI

RELATIVE BETA WEIGHTS OF PREDICTORS OF UNIVERSITY FRESHMAN AVERAGE FOR TWO SCHOOL-SIZE GROUPS

H.S. SIZE	MARK	N	R	RELATIVE BETA WEIGHTS FOR PREDICTORS				
				English 30	Soc. Studies 30	Math. Av.	Science Av.	Foreign Language
Small	P.R.	617	.558	.206	.132	-.031	.295	.055
	Dept.		.560	.112	.214	-.017	.279	.160
Large	P.R.	400	.697	.170	.125	.146	.256	.180
	Dept.		.735	.175	.128	.172	.274	.199

CHAPTER V

EFFECT OF FACULTY ENTERED ON PREDICTION OF FRESHMAN SUCCESS

The improvement of the prediction of freshman success has been enhanced by considering the freshman criterion performance by courses (Zurowski, 1959; Black, 1960). Such breakdowns, however, fail to distinquish between faculties because of the overlapping course programs, notably in Arts, Education, and Science whose students take courses in the other faculties. Mack (1963) examined the problem for four faculties, Arts, Education, Engineering and Science, finding that high school averages were better predictors of freshman success when considered by faculty entered. This chapter examines the influence of individual components of the high school average for the same four faculties studied by Mack.

The study sample was classified by faculty entered and the means, standard deviations for the predictor and criterion variables, the multiple correlation coefficients between predictors and criterion variables, and the regression equations using both Departmental and Principals' Rating scores were calculated. These findings are reported in Tables XVII, XVIII, and XIX.

A comparison of the faculty differences in the ranking of the mean scores on predictor variables indicated that a striking pattern existed for each faculty (Table XVII). By inspection alone, it was obvious that students entering each of the four faculties tended to reflect the prerequisites of that faculty. A comparison using the Freidman Two-way

TABLE XVII

MEANS AND STANDARD DEVIATIONS OF PREDICTOR AND CRITERION VARIABLES FOR FOUR FACULTY GROUPS

VARIABLE		FACULTY							
	N	ARTS 256		EDUCATION 398		ENGINEERING 102		SCIENCE 261	
	STAT.	$\bar{X}$	s	$\bar{X}$	s	$\bar{X}$	s	$\bar{X}$	s
ENGLISH 30	Dept.	72.51	10.40	67.96	10.08	66.99	9.54	69.87	10.63
	P.R.	69.71	9.51	65.91	9.02	64.82	10.79	67.90	10.84
SOCIAL STUDIES 30	Dept.	73.23	10.34	66.65	9.37	70.85	9.83	72.78	10.02
	P.R.	71.28	11.71	67.11	9.79	71.10	10.42	72.21	11.45
MATHEMATICS AVERAGE	Dept.	65.39	10.93	63.66	9.75	74.05	10.65	72.80	11.65
	P.R.	63.11	12.42	63.66	11.61	73.86	9.54	71.77	13.06
SCIENCE AVERAGE	Dept.	67.94	9.76	66.78	7.62	74.07	8.86	73.76	10.13
	P.R.	66.17	11.23	65.94	8.95	70.02	9.13	71.23	11.49
FOREIGN LANGUAGE	Dept.	71.54	12.27	68.58	11.01	67.23	10.68	68.97	12.38
	P.R.	67.58	13.54	65.20	12.40	63.28	12.32	65.89	14.91
UNIVERSITY AVERAGE		61.57	9.52	59.99	8.03	57.49	13.10	62.74	12.37

Analysis of Variance by Ranks (Siegel, 1956; pp. 166-172), rejected the hypothesis that the ranks in the mean scores of the predictor variables were randomly distributed among the faculties. Students who entered Arts had the highest mean scores in three variables--English 30, Social Studies 30, and Foreign Language--and the lowest or second lowest scores in Mathematics and Science. The opposite pattern was shown by Engineering students who had the highest or second highest marks in Science Average and Mathematics Average and the lowest or second lowest in the other variables. Students who entered the Science Faculty had the second highest mean scores in all variables except the Principals' Ratings in Science, in which they ranked highest. Students who entered Education, on the other hand, had the lowest or second lowest mean scores in all of the predictor variables.

The comparison of the multiple correlations between high school scores and university average for each of the faculties provided further evidence to support separate consideration fo the faculties. The multiple correlations between the Departmental marks and the university average ranged from .596 for Education to .750 for Engineering; multiple correlations between the Principals' Ratings and the university average ranged from .584 for Education to .713 for Science (Table XVIII). For both sets of predictors, the correlations with university marks in Engineering and Science were consistently better than the correlations with marks in Arts and Education.

The relative contributions of the predictor variables, as indicated by their relative beta weights, shown in Table XIX, varied from one

TABLE XVIII

MULTIPLE CORRELATIONS BETWEEN PREDICTOR VARIABLES AND UNIVERSITY AVERAGE FOR FOUR FACULTY GROUPS AND SIGNIFICANCE OF DIFFERENCES BETWEEN FACULTY MULTIPLE CORRELATION COEFFICIENTS

FACULTY	MULT. CORR. PRED-UNIV. AV.	SIG. OF DIFF. BETWEEN R's ARTS	EDUC.	ENG.	SCI.
DEPARTMENTAL EXAMINATIONS					
ARTS	.653	-	NSD	.10	.10
EDUCATION	.596		-	.05	.01
ENGINEERING	.750			-	NSD
SCIENCE	.737				-
PRINCIPALS' RATINGS					
ARTS	.607	-	NSD	NSD	.05
EDUCATION	.584		-	NSD	.01
ENGINEERING	.633			-	NSD
SCIENCE	.713				-

TABLE XIX

RELATIVE BETA WEIGHTS OF PREDICTORS OF UNIVERSITY FRESHMAN AVERAGE FOR FOUR FACULTIES

FACULTY	MARK	N	R	BETA WEIGHTS FOR PREDICTORS				
				ENG. 30	SOC. ST.	MATH.	SCIENCE	FOR. LANG.
ARTS	P.R.	256	.607	.238	-.053	.086	.310	.179
	DEPT.	256	.653	.258	-.050	.059	.357	.179
EDUCATION	P.R.	398	.584	.193	.318	-.026	.105	.142
	DEPT.	398	.596	.184	.296	-.018	.192	.163
ENGINEERING	P.R.	102	.633	-.117	.161	.281	.408	-.057
	DEPT	102	.750	-.196	.205	.155	.588	.030
SCIENCE	P.R.	261	.713	.287	.070	.163	.210	.128
	DEPT.	261	.737	.101	.220	.221	.231	.134

faculty to another. Generally, there was a comparatively close relationship between the magnitude of the contribution by the Departmental and Principals' Rating scores from the same subject area. Two exceptions were found, both in the Faculty of Science. The English 30 mark made a markedly greater contribution to the Principals' Rating battery but was the smallest contributor in the Departmental battery. The Social Studies 30 mark showed the opposite effect. It made a greater contribution to the Departmental battery than to the Principals' Rating battery.

The relative beta weight for English 30 was comparatively large for the Faculties of Arts and Science. In the prediction of Engineering marks, it had a negative weighting of considerable magnitude.

The contribution of Social Studies 30 was greater than that of any other predictor variable for the Faculty of Education group. Social Studies 30 made a moderate contribution to the prediction of university average for Engineering students and to the Departmental battery for Faculty of Science marks but a small and negative contribution to prediction in the Faculty of Arts.

The Mathematics Average made little contribution to the prediction of averages in Arts and Education. The Mathematics mark, as might be expected, made a sizeable contribution to prediction in the Faculties of Engineering and Science.

As in earlier studies (Zurowsky, 1959; Black, 1960), the present study found that the Grade XII Science Average was consistently a major contributor to the predictive batteries. Its relative beta weight was particularly large in the Arts and Engineering faculties. The Science

Average was, however, one of the smaller contributors in predicting averages in the Faculty of Education.

The Foreign Language mark made a moderate contribution in predicting marks in all faculties but Engineering, where its contribution was negligible.

In summary, there appeared to be significant faculty differences in the performance by students in the predictor and criterion variables and in the relationship between predictors and criteria.

A comparison of the mean scores indicated that students who enrolled in each faculty had certain relative strengths and weaknesses in their performances on the variables--differences that formed unique faculty patterns, and no doubt determined in part by both the prerequisites of courses in the faculties entered and the interest and aptitude shown by the student choosing that faculty.

Differences of statistical significance were found among the multiple correlations between the predictor and criterion variables for each of the four faculties considered in the study. Correlations for the faculty groups of Science and Engineering were generally greater than correlations for Arts and Education. The correlations for the Faculty of Education group were consistently lower than that of other faculties.

The contributions of each of the predictors, as indicated by the relative beta weights, varied considerably among the faculty groups. The Grade XII Science Average had a heavy beta weighting for the Arts and Engineering groups. The greatest beta weighting for the Education group was for Social Studies 30. Greatest contribution for Faculty of Science

average was the English 30 mark in the Principals' Rating battery and the Science average in the Departmental battery.

It was concluded that there was sufficient evidence to accept the hypothesis that the correlation between high school marks and university average would differ according to the faculty in which the students were enrolled. The development of separate regression equations for each faculty was thereby justified on these as well as a priori evidence from selective admission practices most evident in the Faculties of Science and Engineering.

CHAPTER VI

EFFECT OF SEX DIFFERENCES ON PREDICTION OF FRESHMAN SUCCESS

Academic prediction of freshman success has been found to be more successful for female students than for males (Abelson, 1952; Garrett, 1949; Lewis, 1962; and Seashore, 1962). Not only have high correlations between predictors and criterion been found for females, the variability of scores has been found to be smaller for females (Abelson, 1952). This chapter will report the examination of the hypotheses, first, that the correlation between high school marks and freshman average at the University of Alberta would be greater for female subjects than for male subjects and, secondly, that female predictor and criterion variables would have a greater variance than would the male variables. These hypotheses were tested in four steps. First, the means, standard deviation, and multiple correlation coefficients for both sets of predictor and criterion variables were calculated for the total sample of 457 female and 560 male students. Secondly, the sex breakdown was examined in the two school categories evolved in Chapter IV; and thirdly, for the faculty categories. Finally, the total sample was grouped on the combined categories of sex of the student, size of graduating high school, and faculty entered at the university.

At each stage of this categorization of data, the two hypotheses were tested and the findings reported.

Total Group

The means and standard deviations for the total sample of males and females were computed for each of the predictor variables and differences between the performance of the two groups were analyzed (Table XX).

The female group was found to have a higher mean score and a smaller variance of scores than the male group on the criterion, first-year university average (Table XX). The superior university average would be due, in part, to the absence of female students in the Faculty of Engineering which had lower average marks than the other faculties (Table XVII).

The differences between the male and female groups in their performances on the predictor variables were not entirely consistent with findings of earlier studies, notably Abelson (1952) and Seashore (1963) who had concluded that the variability of scores was less for the female group. The two variables in which a significantly smaller variance was found for the female group, the Principals' Rating scores in English 30 and Foreign Language, were similar in that each was a teacher's rating, as compared to the Departmental Examination, in subject areas in which the mean scores were significantly higher for female students (Table XX). The scores of male students were significantly less variable in the Principals' Rating of Social Studies 30, a subject in which the mean score was greater for male students. Male students also had a higher mean score in the Science Average and in Social Studies 30.

The multiple correlations between the predictor variables and the university freshman average were somewhat greater for the female group

TABLE XX

MEANS AND STANDARD DEVIATIONS OF PREDICTOR AND CRITERION VARIABLES FOR MALE AND FEMALE TOTAL GROUPS AND TESTS OF SIGNIFICANCE OF DIFFERENCE BETWEEN THESE STATISTICS

VARIABLE	STATISTIC	SAMPLE				SIGNIFICANCE OF DIFFERENCE	
		MALES (N =-560)		FEMALES (N = 457)			
		$\bar{X}$	s	$\bar{X}$	s	$\bar{X}$	s
ENGLISH 30	P. R.	65.42	10.16	69.54	9.21	.01	.01
	DEPT.	67.16	9.94	72.36	10.29	.01	NSD
SOCIAL STUDIES	P. R.	70.57	10.68	69.01	11.36	.05	NSD
	DEPT.	71.25	9.54	69.14	10.99	.01	.01*
MATH. AV.	P. R.	68.29	12.38	64.58	12.92	.01	NSD
	DEPT.	69.63	11.33	64.86	11.10	.01	NSD
SCIENCE AV.	P. R.	67.96	10.67	67.52	10.33	NSD	NSD
	DEPT.	70.68	9.51	68.26	9.41	.01	NSD
FOR. LANG.	P. R.	63.17	13.50	68.99	12.57	.01	.05
	DEPT.	66.89	11.26	72.23	11.64	.01	NSD
UNIV. AVERAGE		59.83	11.26	62.09	8.91	.01	.01

*Hypothesis that female students will have smaller variances for variables is rejected because female variance is significantly larger than that found for male students at the 1% level of confidence.

than for the male group, but the differences were not statistically significant for either set of predictors (Table XXI). The correlation coefficients for female students were greater than the coefficients for males by .062 points in the Principals' Ratings and .044 points in the Departmental marks.

The weight scores of the predictor variables in the regression equations for male and female students were transformed to relative beta weights and tabulated for comparison (Table XXI). Social Studies 30 and English 30, both of which contributed heavily to the female battery, were given comparatively little weighting in the male battery. The Mathematics Average was given more weighting in predicting university marks for male students than in predicting university marks for female students. The Science Average was a major contributor to the predictive batteries of male students in particular.

School-size Groups

The data was categorized into the two school-size groups developed in Chapter IV of this study. There were 307 males and 310 females in the small high school group; the large high school group contained 253 males and 147 female students.

An examination of the performance by each group in the predictor and criterion variables confirmed the sex difference found earlier.

On the university average, the female students from both small and large high schools had greater mean scores and smaller variances than the comparable male groups (Table XXII).

TABLE XXI

MULTIPLE CORRELATIONS, STANDARD ERRORS OF ESTIMATE, AND RELATIVE BETA WEIGHTS OF PREDICTOR VARIABLES FOR MALE AND FEMALE GROUPS

GROUP	MARK	R	SE_{est}	RELATIVE BETA WEIGHTS				
				ENG. 30	SOC. ST. 30	MATH. AV.	SCI. AV.	FOR. LANG.
MALE	P.R.	.586	9.17	.181	.080	.102	.272	.098
	DEPT.	.635	8.74	.035	.193	.115	.308	.166
FEMALE	P.R.	.648	6.82	.236	.238	.003	.190	.117
	DEPT.	.679	6.58	.226	.224	.049	.276	.086

TABLE XXII

MEANS AND STANDARD DEVIATIONS OF PREDICTOR AND CRITERION VARIABLE FOR MALE AND FEMALE SCHOOL-SIZE GROUPS

H. S. SIZE	VARIABLE	MARK	MALE		FEMALE		SIG. OF DIFF.	
			$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S
SMALL	ENGLISH 30	P. R.	65.18	9.59	68.45	9.10	.01	NSD
		DEPT.	66.26	9.59	71.17	10.17	.01	NSD
	SOC. ST. 30	P. R.	69.93	10.15	68.95	10.26	NSD	NSD
		DEPT.	70.35	9.67	68.26	10.11	.01	NSD
	MATH. AV.	P. R.	69.00	11.45	64.78	12.20	.01	NSD
		DEPT.	69.07	10.77	64.32	10.10	.01	NSD
	SCI. AV.	P. R.	68.96	9.47	67.72	9.07	NSD	NSD
		DEPT.	70.16	8.93	67.91	8.28	.01	NSD
	FOR. LANG.	P. R.	62.50	12.92	67.66	12.06	.01	NSD
		DEPT.	66.26	10.51	71.03	10.69	.01	NSD
	UNIV. AV.		58.86	10.78	61.04	8.00	.01	.01
LARGE	ENGLISH 30	P. R.	65.71	10.87	71.84	9.05	.01	.05
		DEPT.	68.26	10.72	74.88	10.12	.01	NSD
	SOC. ST. 30	P. R.	71.62	10.32	69.56	12.15	NSD	.05*
		DEPT.	72.35	9.29	71.42	11.02	NSD	.01*
	MATH. AV.	P. R.	67.65	12.73	64.32	13.35	.05	NSD
		DEPT.	70.30	11.96	66.41	11.71	.01	NSD
	SCI. AV.	P. R.	66.98	11.11	67.49	11.32	NSD	NSD
		DEPT	71.30	10.14	69.42	9.93	NSD	NSD
	FOR. LANG.	P. R.	64.18	13.60	72.13	11.89	.01	.05
		DEPT.	67.65	12.02	75.19	11.20	.01	NSD
	UNIV. AV.		61.00	11.72	64.32	10.27	.01	.05

*Greater male variability hypothesis rejected. Evidence statistically favors greater female variability of scores at level indicated.

In the predictor variables, the mean score was higher for the female group in English 30 and Foreign Language for both school-size groups. The smaller variance in the Principals' Ratings of these two subjects, which had been found for females in the total group, was found only for students who graduated from large high schools. In Social Studies 30, the smaller variance in both sets of scores was for the male group in contradiction to the hypothesis. There were no significant differences between the variances of the two groups on the predictor variables for the small school group (Table XXII). Male students from both sizes of high schools, surpassed the females in the Mathematics Average mean score. In the small school group, the males had higher mean scores than the females in the Social Studies 30 and Science Departmental Examination.

The multiple correlation coefficients between high school marks and the university average were consistently numerically greater for the female group as compared to the male group for both small and large school categories (Table XXIII). For only one group, however, was the difference between correlations for male and female groups statistically significant; the correlation coefficient between the Principals' Ratings and university average for the students who graduated from large high schools was .764 for females as compared to .664 for males. This difference was significant at the .05 level.

Faculty Groups

The data for the total groups of male and female students was categorized on the basis of faculty in which the student was enrolled. Since

TABLE XXIII

MULTIPLE CORRELATIONS AND STANDARD ERRORS OF ESTIMATE BETWEEN PREDICTOR VARIABLES AND UNIVERSITY AVERAGE FOR MALE AND FEMALE SCHOOL-SIZE GROUPS AND SIGNIFICANCE OF DIFFERENCE BETWEEN CORRELATION COEFFICIENTS

H. S. GROUP	N_M	N_F	PRED. VAR.	MULTIPLE CORRELATION WITH UNIV. AV.				SIGNIFICANCE OF DIFFERENCE
				MALE		FEMALE		
				R	SE_{est}	R	SE_{est}	
SMALL	307	310	P.R.	.561	9.00	.584	6.54	NSD
	307	310	DEPT.	.555	9.05	.610	6.39	NSD
LARGE	253	147	P.R.	.664	8.85	.764	6.75	.05
	253	147	DEPT.	.718	8.24	.791	6.40	NSD

the sample of Engineering students included only one female student, and she was classed as a male student for faculty comparison, only the Faculties of Arts, Education and Science were considered at this stage of the study. The approximate proportion of males to females was one to one in Arts, one to three in Education, and five to one in Science (Table XXIV).

The mean score of female students surpassed the male mean score in first-year university average in each of the faculties. No significant differences were found between the variance in criterion scores for the male and female groups (Table XXIV).

Female students entering all three faculties had higher mean scores in English 30 and Foreign Language for both sets of predictors as compared to the male mean scores in these variables. Females entering the Science faculty surpassed the males in Social Studies 30. The mean score for male students in Education was higher than the mean score for female Education students in the Departmental Mathematics Average. The mean score for the Principals' Rating of the Science Average was greater for males than females in Education but greater for females than males in the Faculty of Science (Table XXIV).

Considering the variances of the scores of male and female students for both Departmental and Principals' Rating scores, only one instance was found when the female variance was significantly smaller than the male variance, but eight instances were found when the female variance was significantly greater than the male variance. For the remaining twenty-four comparisons, no significant differences were found. This evidence in contrast to Abelson's (1952) findings would suggest that the hypothesis

TABLE XXIV

MEANS AND STANDARD DEVIATIONS OF PREDICTOR AND CRITERION VARIABLES FOR MALE AND FEMALE FACULTY GROUPS

VARIABLE	SCORE	SEX	ARTS				EDUCATION			
			$\overline{X}$	sig.	s	sig.	$\overline{X}$	sig.	s	sig.
ENGLISH 30	P.R.	M	67.74		9.01		61.10		8.61	
		F	71.98	.01	9.60	NSD	67.65	.01	8.53	NSD
	DEPT.	M	69.52		9.79		61.65		8.10	
		F	75.96	.01	10.05	NSD	70.25	.01	9.75	.05*
SOCIAL STUDIES 30	P.R.	M	71.88		9.50		66.35		9.24	
		F	70.59	NSD	13.84	.01*	67.38	NSD	9.99	NSD
	DEPT.	M	73.81		8.47		66.82		7.95	
		F	72.57	NSD	12.14	.01	66.59	NSD	9.84	.01*
MATHEMATICS AVERAGE	P.R.	M	62.67		10.48		64.07		10.84	
		F	63.61	NSD	14.36	.01*	63.50	NSD	11.89	NSD
	DEPT.	M	64.80		9.30		66.07		9.94	
		F	66.80	NSD	12.56	.01*	62.78	.01	9.54	NSD
SCIENCE AVERAGE	P.R.	M	65.23		9.47		64.25		9.09	
		F	67.25	NSD	12.92	.01*	66.55	.05	8.83	NSD
	DEPT.	M	67.25		7.72		66.39		7.21	
		F	68.73	NSD	11.66	.01*	66.92	NSD	7.78	NSD
FOREIGN LANGUAGE	P.R.	M	63.07		11.89		61.56		13.84	
		F	72.77	.01	13.50	NSD	66.52	.05	11.58	.05
	DEPT.	M	67.27		10.08		64.78		11.90	
		F	76.46	.01	12.76	.05*	69.96	.01	10.35	NSD
UNIVERSITY AVERAGE		M	59.31		9.56		58.13		7.65	
		F	64.18	.01	8.83	NSD	60.66	.01	8.07	NSD
			$N_M = 137$ $N_F = 119$				$N_M = 106$ $N_F = 292$			

* Greater male variability hypothesis is rejected
Evidence statistically favors greater female variance at level indicated.

TABLE XXIV (Continued)

VARIABLE	SCORE	SEX	ENGINEERING				SCIENCE			
			$\bar{X}$	sig.	S	sig.	$\bar{X}$	sig.	S	sig.
ENGLISH 30	P.R.	M	64.82		10.79		66.38		10.62	
		F					75.22	.01	8.79	NSD
	DEPT.	M	66.99		9.54		68.56		10.17	
		F					76.16	.01	10.64	NSD
SOCIAL STUDIES 30	P.R.	M	71.10		10.42		71.61		11.66	
		F					75.11	.05	9.97	NSD
	DEPT.	M	70.85		9.83		72.05		10.05	
		F					76.29	.01	9.18	NSD
MATHEMATICS AVERAGE	P.R.	M	73.86		9.54		71.32		13.28	
		F					73.89	NSD	11.81	NSD
	DEPT.	M	74.05		10.65		72.34		11.81	
		F					74.93	NSD	10.68	NSD
SCIENCE AVERAGE	P.R.	M	70.02		9.13		70.56		11.80	
		F					74.49	.05	9.28	NSD
	DEPT	M	74.07		8.86		73.33		10.30	
		F					75.82	NSD	9.11	NSD
FOREIGN LANGUAGE	P.R.	M	63.28		12.32		64.04		14.80	
		F					74.78	.01	12.06	NSD
	DEPT.	M	67.23		10.68		67.61		11.89	
		F					75.51	.01	12.68	NSD
UNIVERSITY AVERAGE		M	57.49		13.10		61.99		12.50	
		F					66.42	.05	11.18	NSD
			N_M = 102				N_M = 216 N_F = 45			

of smaller female variances be rejected and replaced with one of no significant differences between male and female variances.

The multiple correlation between high school achievement and university average in each of the three faculties was consistently greater for female students than for male students (Table XXV). The correlations between the Arts average and each of the two sets of predictors were significantly greater for the female group at the .01 level. The correlation between the Education average and Departmental marks was greater for the female group at the .05 level of significance.

Faculty and School-size Groups

Finally, the data was grouped on the basis of sex of the student for each of three faculties, and then categorized further on the basis of size of graduating high school. In this way, some twelve subgroups evolved. The multiple correlation coefficients between the batteries of high school marks and the university average were computed and tabulated. The difference between the correlations for marks of male and female students in each of the subgroups was tested for significance. This is reported in Table XXVI.

The multiple correlations for female students were consistently greater than for males. These differences in correlation coefficients were statistically significant for marks in Arts and Science faculties. None of the sex differences in correlations between high school marks and Education average were significant.

The standard error of estimate was consistently smaller for female

TABLE XXV

MULTIPLE CORRELATION COEFFICIENTS BETWEEN PREDICTOR VARIABLES AND UNIVERSITY AVERAGE FOR MALE AND FEMALE FACULTY GROUPS

FACULTY	SIZE		MARK	CORR. WITH UNIV. AV.				SIG. OF DIFF. in R
	MALE	FEMALE		MALE		FEMALE		
				R	SE_{est}	R	SE_{est}	
ARTS	137	119	P.R.	.483	8.51	.696	6.47	.01
			DEPT	.558	8.08	.746	6.01	.01
EDUCATION	106	292	P.R.	.521	6.69	.607	6.47	NSD
			DEPT	.470	6.92	.634	6.29	.05
SCIENCE	216	45	P.R.	.698	9.05	.800	7.12	NSD
			DEPT	.722	8.74	.796	7.18	NSD

TABLE XXVI

MULTIPLE CORRELATION COEFFICIENTS BETWEEN PREDICTOR VARIABLES AND UNIVERSITY AVERAGE FOR MALE AND FEMALE SCHOOL-SIZE AND FACULTY GROUPS

FACULTY	H. S. SIZE	N_M	N_F	PRED. VARIABLES	CORR. WITH UNIV. AV.				SIG. OF DIFF.
					R_{Male}	SE_{est}	R_{Female}	SE_{est}	$R_M - R_F$
ARTS	Small	61	59	P.R.	.488	9.01	.635	6.08	NSD
		61	59	DEPT.	.444	9.26	.693	5.67	.05
	Large	76	60	P.R.	.528	8.17	.769	6.63	.01
		76	60	DEPT.	.733	6.54	.826	5.83	NSD
EDUC.	Small	80	228	P.R.	.556	6.92	.607	6.18	NSD
		80	228	DEPT.	.495	7.14	.635	6.01	NSD
	Large	26	64	P.R.	.578	5.85	.653	7.33	NSD
		26	64	DEPT.	.640	5.51	.651	7.34	NSD
SCIENCE	Small	107	22	P.R.	.693	8.49	.671	8.28	NSD
		107	22	DEPT.	.632	9.14	.621	8.76	NSD
	Large	109	23	P.R.	.788	8.44	.926	4.99	.05
		109	23	DEPT.	.799	8.23	.909	5.52	.05

students than for male students in all subgroups except graduates of large high schools who entered the Faculty of Education.

Regression Equations

It was felt that sufficient evidence had been gathered to justify a differentiation of the data on the basis of sex of the student (Chapter VI), size of graduating high school (Chapter IV), and faculty entered at university (Chapter V). The multiple correlations between first-year university average and each of the Principals' Rating and Departmental Examination batteries were computed for each of the fourteen subgroups formed on the basis of these differentiations (Tables XXVII and XXVIII). The multiple regression equations to enable the computation of university average from either the Principals' Ratings or the Departmentals are shown on Tables XXVII and XXVIII together with the standard error of estimate for each subgroup.

Summary

There appeared to be consistent differences in the performance of the male and female groups in the predictor and criterion variables. The mean score for females was consistently and significantly greater than the mean score for males in the university freshman average; the variance of female scores was less than the variance of male scores in the university average. On the predictor variables there was a consistent trend for female mean scores to be greater in English 30 and Foreign Language. The male scores tended to be greater in Social Studies 30, Mathematics Average, and Science Average particularly for students who

TABLE XXVII

COMPONENTS OF REGRESSION EQUATIONS AND MULTIPLE CORRELATION COEFFICIENTS BETWEEN DEPARTMENTAL MARKS AND UNIVERSITY AVERAGE

FACULTY	H.S.	N	Corr. With Univ. Av. R	BETA WEIGHTS FOR PREDICTORS					K	SE_{est}
				ENG. 30	SOC. ST.	MATH. AV.	SCI. AV.	FOR. LANG.		
MALE STUDENTS										
ARTS	Small	61	.444	- .017	.267	.121	.298	- .024	13.43	± 9.26
	Large	76	.733	.131	- .138	- .075	.609	.312	4.14	± 6.54
EDUC.	Small	80	.495	.003	.195	- .066	.016	.338	25.47	± 7.14
	Large	26	.640	.156	.255	.004	.197	.075	15.24	± 5.51
ENGIN.	Small	60	.732	- .239	.203	- .062	1.087	.094	-22.67	± 9.41
	Large	42	.831	- .262	.245	.552	.492	- .037	-17.43	± 7.73
SCIENCE	Small	107	.632	.040	.303	.059	.401	.085	- 2.23	± 9.14
	Large	109	.799	.111	.260	.411	.173	.165	-18.31	± 8.23
FEMALE STUDENTS										
ARTS	Small	59	.693	.229	- .016	.131	.310	.032	14.68	± 5.67
	Large	60	.826	.322	.029	.070	.312	.203	- 3.93	± 5.85
EDUC.	Small	228	.635	.126	.309	- .014	.210	.067	13.35	± 6.01
	Large	64	.651	.195	.139	.097	.357	.036	5.54	± 7.34
SCIENCE	Small	22	.621	.159	.104	.238	.200	.096	3.85	± 8.76
	Large	23	.909	.346	.093	.236	.401	.164	-25.96	± 5.52

TABLE XXVIII

COMPONENTS OF REGRESSION EQUATIONS AND MULTIPLE CORRELATION COEFFICIENTS BETWEEN PRINCIPALS' RATINGS AND UNIVERSITY AVERAGE

FACULTY	H.S.	N	Corr. With Univ. Av. R	BETA WEIGHTS FOR PREDICTORS					K	SE_{est}
				ENG. 30	SOC. ST.	MATH. AV.	SCI. AV.	FOR. LANG.		
MALE STUDENTS										
ARTS	Small	61	.488	.274	- .054	- .034	.445	- .032	18.07	± 9.01
	Large	76	.528	.171	- .034	.077	.257	.116	22.42	± 8.17
EDUC.	Small	80	.556	.198	.078	.050	- .095	.227	29.07	± 6.92
	Large	26	.578	.072	.163	- .021	.092	.138	32.37	± 5.85
ENGIN.	Small	60	.588	- .086	.217	.254	.705	- .162	-11.56	±11.18
	Large	42	.740	- .192	.063	.629	.552	- .015	-17.02	± 9.36
SCIENCE	Small	107	.693	.266	.187	- .071	.547	.035	- 6.08	± 8.49
	Large	109	.788	.214	.106	.277	.259	.159	- 7.41	± 8.44
FEMALE STUDENTS										
ARTS	Small	59	.635	.148	.074	.073	.166	.054	27.45	± 6.07
	Large	60	.769	.160	.075	.019	.329	.196	10.27	± 6.63
EDUC.	Small	228	.607	.172	.290	- .079	.197	.014	20.22	± 6.18
	Large	64	.653	.179	.321	.081	.064	.147	8.83	± 7.33
SCIENCE	Small	22	.671	- .445	.023	.014	.504	.550	15.97	± 8.28
	Large	23	.926	.203	.390	.220	.140	.154	14.48	± 4.99

graduated from small high schools and for those who entered the Faculty of Science. The anticipated smaller variances for scores of female students were not consistently found in this study, so much so that the hypothesis relating to this relationship was rejected.

The correlations between the high school marks being used as the predictors and the university freshman average were found to be consistently greater for females than for males. The superiority of the female correlation coefficients was not statistically significant in all cases. When the sample was considered on the basis of school size, the female correlation coefficient was significantly greater than the male coefficient only for the Principals' Rating scores of students who graduated from large high schools (Table XXIII). For the faculty groups, a statistical difference in favor of the female correlation coefficient was found for both the Principals' Rating and Departmental scores in predicting the Education average (Table XXV). When size of high school and faculty entered were considered jointly, the female correlation coefficient was significantly greater statistically for the Departmental scores of students graduating from small schools and entering the Faculty of Arts, for the Principals' Rating scores of students from large schools entering Arts, and for both types of scores of students from large high schools entering the Faculty of Science (Table XXVI).

A comparison of the relative beta weights of the individual predictors in the battery (Table XXI) indicated that the weighting of the predictors differs for the male and female batteries.

On the basis that there were evidences of sex differences in

performance on predictor and criterion variables and in the relationship between both sets of predictors and university freshman average, a differentiation between male and female students was felt to be justified.

Moreover, coupled with sex differences, there was justification for a further breakdown according to faculty entered and size of high school from which the student had graduated. Regression equations were developed to predict freshman success on this three-part categorization for both Principals' Rating and Departmental Examination scores.

CHAPTER VII

RELATIVE PREDICTIVE EFFICIENCY OF DEPARTMENTAL AND PRINCIPALS' RATING SCORES

A major hypothesis of this study stated that the Principals' Rating scores would be as effective predictors of university freshman success as would the Grade XII Departmental Examinations. This chapter will seek to examine this hypothesis in detail.

It will be noted in the earlier chapters reporting the findings of the study that both Departmental and Principals' Rating statistics have been reported side by side but no comparisons were made other than those obvious from the data such as the general tendency of Principals' Ratings to underestimate the score actually achieved in the Departmental Examination, a tendency more apparent for male than female students, for large high schools than small schools. This has been done on the assumption that, for the purposes of this study, each represents a distinct rating system. The similarities of the two systems of scores, however, have been readily apparent throughout the earlier analyses of this study. The principal reason for this studies' consideration of these two sets of predictors as separate systems lies in the fact that the Principals' Ratings could be available to the school counsellors and university officials several months before the Departmental scores. The basic point of comparison, therefore, was the relative effectiveness of the Principals' Ratings and the Departmental Examinations to predict freshman success.

Following the pattern of previous chapters, these comparisons of Departmental and Principals' Rating scores will be examined on the basis of a categorization of the study sample according to sex, size of graduating high school, and faculty entered. The multiple correlation coefficients for each battery of scores are reported in Table XXIX.

Multiple correlation coefficients between the Principals' Rating battery and university freshman average ranged from .488 to .926 with a median coefficient of .644; multiple correlation coefficients for the Departmental battery ranged from .444 to .909 with a median coefficient of .672. In one of the fourteen subgroups, male Arts students from large high schools, the coefficient of the Departmental-university correlation (R_D = .733) was significantly greater statistically than the correlation coefficient of Principals' Ratings with the university average (R_{PR} = .528). In seven other subgroups, the Departmental battery produced greater correlation coefficients but the advantage over the Principals' Rating battery was not statistically significant. In the remaining nine subgroups, the difference between the correlation coefficients produced by each of the batteries was in favor of the Principals' Rating scores but, again, the differences were not statistically significant.

The Principals' Rating battery was therefore found to be generally as effective a predictor of university success as the Departmental Examination battery. When differentiation was made among the data on the basis of size of high school, faculty entered, and sex of student, university success was predicted significantly more effectively

TABLE XXIX

COMPARISON OF DEPARTMENTAL EXAMINATIONS AND PRINCIPALS' RATINGS AS PREDICTOR VARIABLES FOR FACULTY, SEX, AND SCHOOL-SIZE SUBGROUPS

FACULTY	SEX	H. S. SIZE	N	MULT. CORR. WITH UNIV. AV.				SIG. OF DIFF.
				PRINCIPALS' RATINGS		DEPARTMENTALS		
				R_{PR}	SE_{est}	R_D	SE_{est}	$R_{PR} - R_D$
ARTS	M	Small	61	.488	9.01	.444	9.26	NSD
		Large	76	.528	8.17	.733	6.54	.05
	F	Small	59	.635	6.07	.693	5.67	NSD
		Large	60	.769	6.63	.826	5.83	NSD
EDUC.	M	Small	80	.556	6.92	.495	7.14	NSD
		Large	26	.578	5.85	.640	5.51	NSD
	F	Small	228	.607	6.18	.635	6.01	NSD
		Large	64	.653	7.33	.651	7.34	NSD
ENGIN.	M	Small	60	.588	11.18	.732	9.41	NSD
		Large	42	.740	9.36	.831	7.73	NSD
SCIENCE	M	Small	107	.693	8.49	.632	9.14	NSD
		Large	109	.788	8.44	.799	8.23	NSD
	F	Small	22	.671	8.28	.621	8.76	NSD
		Large	23	.926	4.99	.909	5.52	NSD

by the Departmental scores in only one of the fourteen subgroups. The median difference between the multiple correlation coefficients produced by the two batteries was 0.028 in favor of the Departmental battery. The practical advantages of the Principals' Rating in terms of availability to the high school counsellor before the end of the Grade XII program would appear to offset the slight loss in predictive efficiency. For University admissions, the slight loss would in no way negate their use for early provisional admission pending the satisfactory achievement on the Grade XII Departmental Examinations.

CHAPTER VIII

SUMMARY, CONCLUSIONS, AND APPLICATIONS

The general problem of the present study was, first, to ascertain the improvement in the prediction of freshman success at the University of Alberta, Edmonton by studying the single and combined categorization of predictor data according to the sex of the student, the size of the graduating high school, and the faculty entered by the student. Secondly, using this categorization, the relative predictive values of the Principals' Rating and Grade XII Departmental Examination scores were examined.

Data was collected and analyzed in accordance with four hypotheses and the findings of this study were as follows:

1. It was hypothesized that high school marks of students who had attended larger high schools would produce greater correlation with university average than would marks of the students from smaller high schools. The only such categorization of size of high school, as determined by the number of teachers on staff, that was found to be justified was the division of schools into those with twenty-five or fewer teachers (small high schools) and those with more than twenty-five teachers (large high schools). Any finer categorization was not warranted, a finding compatible with that of Bou and Stovell (1950) who categorized high schools for similar purposes into those with less than 500 students and those with 500 or more students.

2. It was hypothesized that the value of a predictive variable or battery of variables in ideal combination would differ from one faculty group to another. The findings indicated that the value of the predictive batteries was greatest for the Faculties of Engineering and Science, and least for Education and Arts, respectively. These findings are comparable to those of Mack (1963) in rank, but in every instance, the multiple correlation coefficients obtained by this study were numerically larger than the correlations obtained by Mack's use of the high school average mark. Although there were no significant differences in the size of validity coefficients between Engineering and Science, and between Arts and Education when the Departmental scores were used to predict freshman success, the magnitude and ranking of the various predictor variables and their relative contribution to the prediction of success, would warrant their separate consideration.

3. It was hypothesized that the correlation between high school marks and university average would be greater for female students than for male students. While the generally consistent finding was that predictions can be made more accurately for female students, the differences in the correlation coefficients were not always statistically significant. The hypothesis suggested by the findings of Abelson (1952) that scores of female students were less variable than scores of male students was rejected by the finding of this study that there were no consistent differences in the variances. There was some evidence to support the finding by Carter (1953) that ratings of males were greater underestimations of actual marks than were ratings of females.

4. Finally, it was hypothesized that the use of Principals' Rating scores would lead to as great a correlation with university freshman average as would the use of Grade XII Departmental Examinations. For one of the fourteen subgroups formed by the categorization developed in this study, there was statistical evidence to reject this hypothesis but in all other subgroups, the differences between the correlation coefficients produced by each of the two predictive batteries were not statistically significant. It was concluded that although the Departmental Examinations led to slightly greater correlations with university freshman success on the average, the Principals' Rating scores could be effectively used for counselling and provisional university admission purposes.

Applications

From this study, there appeared to be considerable evidence that the regression equations using Principals' Rating would permit effective educational counselling with empirical data as early as two months before the end of the Grade XII school term.

One method of presenting data from regression equations in graphic form for counselling purposes has been proposed by Black (1960). An example of the use of such a predictive chart, using the data of this study, would be to plot the chances of success, i.e., earning a mark of 50 per cent or better in first-year university, in each of the four faculties for a boy from a small high school with Principals' Rating of 70 in English, 65 in Social Studies, 80 in Mathematics, 65 in Science,

and 60 in Foreign Languages. By inserting these ratings in the appropriate regression equations, it would be found that this student's predicted marks would be 50 in Arts, 39 in Education, 77 in Engineering, and 74 in Science. To take into account the standard errors of estimate, the counsellor would chart the predicted marks on the "Prediction Profile" (Figure I) to illustrate the chances that these predicted marks would result in a pass mark on the basis of performance by past years' students.

The expectancy chart suggested by Mack (1963), while extremely useful, unfortunately was designed for studies which employed a single predictor variable, such as the high school average, and was not appropriate for the multiple prediction technique used in the present study. An adaptation could be made, however, by using predicted scores from the regression equations on one axis and actual grades achieved on the other. As before, the problem of computing the predicted scores for large numbers of students without calculator and computing devices remains.

The Need for Further Research

The finding of the present study that the Principals' Ratings led to nearly as precise a prediction of university freshman success as did the Departmental Examinations suggested several areas for future study.

1. The technique of multiple differential prediction tends to emphasize relationships found only in the particular sample drawn. While the present study included the majority of the 1962-63 freshman

FIGURE I

UNIVERSITY SUCCESS PREDICTION PROFILE

GROUP: Male Students from Small High Schools

DIRECTIONS: Chart the total score from the regression equations

FACULTY	CHANCES OF RECEIVING A PASSING UNIVERSITY AV. (50%)				
	Very Doubtful	Doubtful	Risky	Fair	Good
ARTS	Below 34	35 - 45	46 - 52	53 - 65	66 - Above
EDUCATION	Below 41	42 - 46	47 - 52	53 - 59	60 - Above
ENGINEERING	Below 36	37 - 44	45 - 53	54 - 64	65 - Above
SCIENCE	Below 39	40 - 46	47 - 52	53 - 61	62 - Above

class in the faculties considered, the results should be examined in light of cross-validation studies of succeeding first-year classes before general application of the findings can be made. Black (1964) has found in a study of Engineers at the University of Alberta that regression equations developed in 1956 were comparatively stable over a period of six years. While this holds promise for operational uses, it is apparent that predictions for other faculties should be similarly investigated.

2. Consideration should be taken of the contribution of an intelligence test score as part of the predictive battery with the Principals' Rating scores. While it has been found that intelligence tests generally add little to the provincial achievement test battery score for prediction, due in part to the high correlation between the two, it would seem possible that Principals' Ratings and intelligence tests might well be relatively uncorrelated and able to complement one another in predicting university success.

3. Examination of the predictive abilities of the average score of Principals' Ratings as compared to that of the Departmental average score should be made. The use of a single predictor would simplify the task of presenting expectancy tables for counselling purposes, hopefully with little loss in predictive efficiency.

4. The problem of predicting future academic success from high school scores could well include, as criteria, success in institutions in addition to the University of Alberta. The growth of junior colleges and technological institutes necessitates the compiling of data

regarding the relationship between high school marks and success in all post-high school programs.

5. There appears to be a growing need for interprovincial studies. The relationship between Alberta high school marks and success in institutions of higher learning in other provinces has become increasingly important as family mobility and the practice of faculty quotas increase in Canada.

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